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PSEUDOFRACTURES IN DISEASES AFFECTING THE SKELETAL SYSTEM[1]

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PSEUDOFRACTURES may be described as transverse zones of rarefaction varying in width from less than a millimeter to more than a centimeter, affecting various portions of the skeletal system and usually symmetrically distributed. They are mistaken frequently for true fractures and, since they are generally an indication of certain weaknesses or dysfunction of the skeletal system, it is important that their true character be identified. Several authors have concluded that certain of these lesions constitute a new disease entity, while others have reported them under a great variety of names, such as pseudofractures (36), spontaneous fractures (61), Looser's zones (23), Umbauzonen (48), Umbaufrakturen (63), multiple spontaneous idiopathic symmetrical fractures (56), osteoporosis melolytica (47), march fractures (19), and insufficiency fractures (33). Because of the obvious confusion regarding the significance of the condition and the relationship of the different forms which it assumes, this study was undertaken in an attempt to ascertain the relation of the lesions to one another and to determine whether or not there is any justification for considering them a new disease entity.

Roentgenographically these skeletal defects show three different forms. (1) Those associated with certain malacic diseases may appear as small, subperiosteal notches in the cortex when viewed tangentially, or as small, irregularly circular, punched-out zones of decalcification when viewed *en face* (Figs. 1 and 2). This type of defect slowly progresses across part or all of the bone as a band of decalcification, finally appearing as if the lime salts had been erased in that area without disturbing the continuity of the bone (Figs. 3 and 4). The margins of these zones are usually straight and lie at right angles to the long axis of the bone. They may, however, be irregular, diagonal, or Z-shaped. The ends of the bony fragments adjacent to the band of pseudofracture may show a narrow zone of increased density. A periosteal reaction is sometimes observed in the region of the defect, and in curved bones may be apparent only on the concave side. (2) Those lesions not associated with malacic disease may be revealed as cracks or fissures extending through the cortex on one side, most often on the convex surface in pathologically curved bones (Figs. 5 and 6). (3) The third type of lesion ap-

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pears as a fusiform callus formation and periosteal reaction only (Fig. 7). No crack or zone of decalcification is apparent roentgenographically.

The condition involves flat bones as well as long bones and may be widespread throughout the skeletal system (Fig. 8). In advanced cases it has a tendency to affect paired bones in a more or less symmetrical manner, although single lesions may be found. The defects differ from actual fractures in several respects. They appear to develop spontaneously without gross trauma, but gross trauma may con-

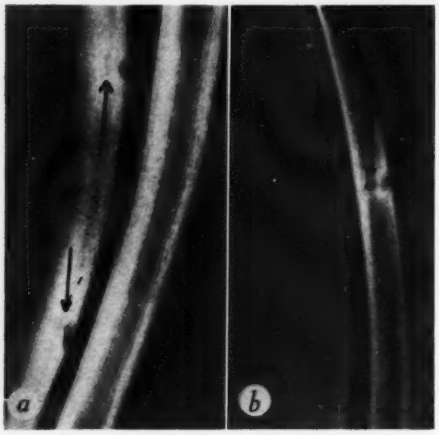

Fig. 1. *a.* Two early pseudofractures appearing as notches in the cortex of the fibula in a case of osteogenesis imperfecta.
b. Pseudofracture appearing as small, irregularly circular, punched-out zone of decalcification when viewed *en face.*

vert them into true fractures (Figs. 3*b* and 6*b*). Although certain of these pseudofractures appear roentgenographically as discontinuities of the bony framework, there is no separation or rotation of the apparent fragments, nor is there any crepitus or undue mobility except that a slight degree of elastic "give" may be elicited if sufficient pressure is exerted over the affected region (48).

One of the earliest records of bilateral spontaneous fractures is that of Parker, who in 1882 reported the postmortem examination of the thorax of a child aged twelve months with a rickety deformity and spontaneous fractures of several ribs on each side. These fractures showed no evidence of ecchymosis within or without the periosteum and no sign of repair. Feiss, in 1905, reported the case of a child aged four years suffering from rickets, who showed multiple spontaneous fracture-like zones bilaterally, with no displacement of the fragments nor any evidence of true fracture. He referred to the reports of M. John of Breslau, who had found several instances of spontaneous fractures in cases of rickets but considered that rickets alone could not be held responsible for the lesions.

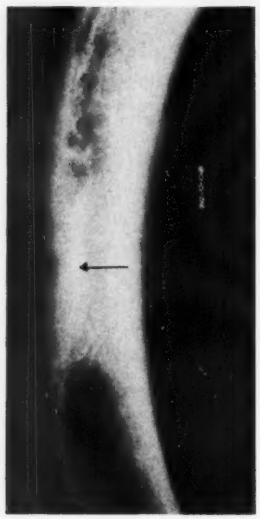

Fig. 2. Early pseudofracture on the lateral aspect of a pathologically curved femur in a case of renal rickets.

John further pointed out that, in spite of the many fractures, there were no marked deformities except those due to the bowing consequent to the rachitic process. He remarked on the tendency of the fracture-like zones, in his cases, to heal without treatment and expressed the opinion that the process was a special disease, not rickets, and not closely related to osteotabes infantum, osteogenesis imperfecta, osteomalacia, or osteopsathyrosis. In the discussion of Feiss's paper, several clinicians mentioned similar cases in which the lesions persisted despite treatment.

Reports by Hagemann and Eringhaus in 1911, on the occurrence of spontaneous fractures in late rickets, are mentioned by Fromme (22), but it was during the years immediately following the World War that the greatest number of cases of pseudofractures was reported. Most of these occurred in association with the "hunger osteomalacia" following the food shortage in Central Europe, and their occurrence led to a great deal of work on the relationship of osteomalacia, late rickets, and rickets, particularly by Looser (48, 49). His work was especially outstanding because of its comprehensive nature and the thoroughness with which the findings were presented. Because of it the lesions are frequently referred to as "Looser zones," although Looser himself used the term *Umbauzonen*, or zones of reconstruction.

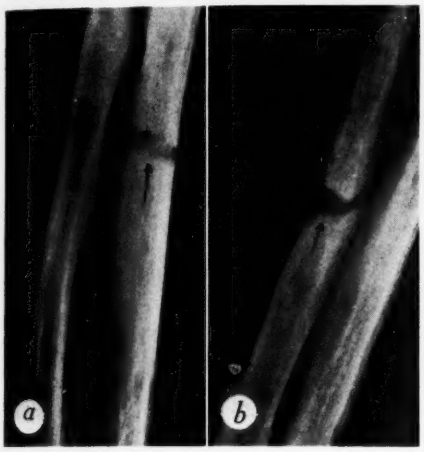

Fig. 3. *a*. Pseudofracture in a case of osteomalacia, showing a wide band of decalcification extending completely through the left ulna; there is no displacement or rotation of the fragments.
b. A similar lesion in the right radius which has progressed to the stage of true fracture as a result of additional trauma. There were similar lesions in the metacarpals on both sides.

Milkman (55, 56), in 1930 and 1934, reported a case showing widespread involvement of the skeleton with pseudofractures, in which no form of treatment appeared to be of any benefit. The patient died after the progress of the lesions had been observed over a period of several years. The postmortem findings are recorded in Milkman's second paper. He was unable to classify the condition as any known type of skeletal disease, and came to the conclusion that it represented a new disease entity, which he named multiple spontaneous idiopathic symmetrical fractures. This opinion had been previously expressed by Hass. Following Milkman's report, several authors recorded somewhat similar cases under the name of Milkman's syndrome (15, 24, 29). More recently, Leedham-Green and Golding (47) described a comparable case under the name of osteoporosis melolytica, and concluded that the condition is a distinct clinical entity.

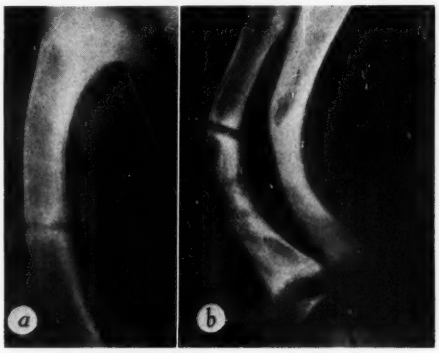

Fig. 4. *a*. Complete pseudofracture through the midshaft of the femur in a case of severe late rickets; the lesion appears as a wide band of decalcification without displacement of the apparent fragments; there is some periosteal buttressing on the concave aspect of the bone.
b. A similar lesion present in the right radius; the rachitic changes in the metaphyses of the radius and ulna may be seen.

We are unable to agree with the conclusion that these lesions constitute a new disease entity, since they may be produced experimentally in a way that denies that contention, and since they occur in association with a great variety of conditions not closely related. The following list indicates the conditions in which pseudofractures have been observed by us or in which they have been reported by others: osteomalacia (9, 13, 16, 24, 29, 30, 34, 36, 37, 38, 48, 49, 51, 63, 75), rickets and late rickets (7, 21, 36, 40, 48, 51, 60, 61, 63, 71, 73), renal rickets (12, 62, 66, 78), celiac disease,

chronic idiopathic steatorrhea, Gee's disease, non-tropical sprue, sprue (5, 10, 11, 31, 32, 37, 44, 61, 72, 74), early and late osteogenesis imperfecta (12, 21, 27, 36, 48, 70, 71), fragilitas ossium, hyperparathyroidism (2, 3, 4, 5, 12, 18, 26, 35, 38, 54, 57, 58, 66), hyperthyroidism (6, 14, 25, 46, 57, 58, 60, 65, 73), osteitis deformans (Fig. 9) or Paget's disease (2, 12, 27, 44, 69, 71, 72, 77), adrenal-pituitary bone dystrophy (6, 13, 50, 57), severe chronic acidosis or hyperglycemia (6, 25, 38, 45), congenital syphilis (12, 27, 36, 48, 52, 70, 76), osteomyelitis, osteopetrosis (marble bones, osteosclerosis fragilis generalisata) (1, 42, 43, 64), states of overloading of bone (march fracture, insufficiency fracture) (9, 17, 19, 27, 33, 34, 36, 42, 46, 53, 59, 60, 67, 79), and certain blood dyscrasias (5). It is thus seen that pseudofractures have been observed in many conditions (20) with totally different etiologic factors, and that the only feature common to all these conditions is weakening of the bony framework or excessive load on the bone.

Fig. 5. Multiple pseudofractures of the fissure type occurring in a case of renal rickets.

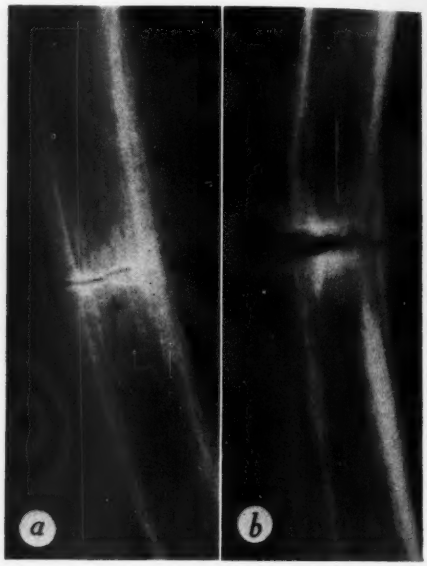

Fig. 6. *a*. Fissure type of pseudofracture occurring on the convex aspect of the midportion of the left femur in a case of osteogenesis imperfecta tarda.
b. A more advanced lesion in the opposite femur which has progressed to the stage of true fracture as a result of additional trauma.

Pseudofractures are most commonly found in the tibia, femur, superior and inferior rami of the pubis and inferior ramus of the ischium (Fig. 10), the metatarsals (Figs. 7 and 11), ribs, radius, and ulna. They occur less frequently in the fibula, clavicle, metacarpals, and along the axillary border of the scapula and base of the coracoid process. They are more rare in the humerus, phalanges, carpus, tarsus, and ilium. They have been reported as occurring in the patella, in bone grafts, and in the vertebrae. In the latter situation it would seem to be extremely difficult to dis-

tinguish these lesions from compression fractures, which are the defects most commonly associated with diseases weakening the structure of the vertebral bodies, and from the anterior vascular channels, which are sometimes prominent. It has been suggested that the defect in the neural arch of a vertebra leading to spondylolisthesis may

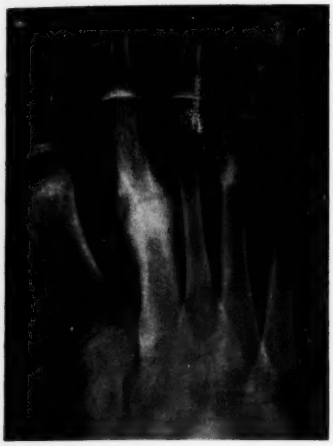

Fig. 7. So-called march fracture, showing a fracture line and periosteal reaction. A fracture line may not be visible in lesions of this type.

be identical with pseudofractures in other situations (68). Multiple lesions may be found in the same bone.

Many different factors have been implicated in the causation of these skeletal defects. Infection (60), sympathetic bone disease, affections of the periosteum and marrow (27), hormonal influences (23, 36), circulatory disturbances (53), and diseases of the central nervous system have all been mentioned. While certain authors (30, 34, 47, 56) have considered the condition to be a separate disease entity, others have endeavored to show that the major factor in the production of these lesions is excessive strain on bones that are either weakened by disease or are incapable, in the healthy state, of sustaining unusual demands made on them (8, 12, 19, 23, 27, 33, 44, 48, 49, 59, 60, 63, 70, 71, 77). Our own experience, as previously mentioned, supports the latter hypothesis.

Greig has shown that disturbance of the local blood supply to bone tissue is capable of causing great variations in its structure. In order to bring this mechanism into play, however, there must be local damage to the bone if focal changes such as pseudofractures are to be produced. Hormonal influence is capable of producing wide-

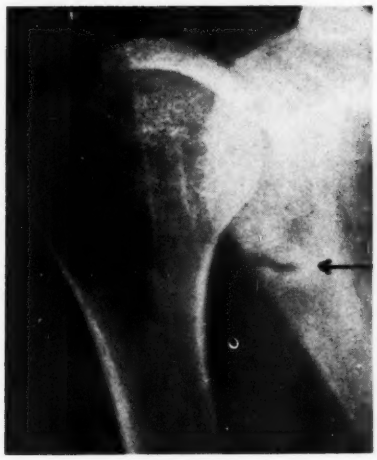

Fig. 8. Single pseudofracture in the axillary border of the scapula below the glenoid fossa, occurring in a case of osteomalacia resulting from dietary insufficiency.

spread changes in certain tissues, but it is hardly conceivable that circumscribed oseous lesions of this type, in some casess single isolated lesions, could be produced by substances as widely circulated as hormones. Nor is it conceivable that infections and emboli alone are capable of accomplishing such a change since it is known that interruption of the blood supply to bone tissue will not cause a rarefaction but will result in death of the bone and the appearance of sclerosis. Gratsianskiy has shown, further, that infection is probably not a factor in the formation of these lesions. He performed diagnostic punctures and excisions on the affected bones in certain of his cases and the bacteriologic studies yielded entirely negative results. That affections of the central or of the autonomic nervous system could be responsible for such definitely localized lesions in one tissue

without other manifestations is also highly improbable, more particularly as no pathologic changes in the nervous system have been demonstrated which seem to bear any relation to the lesions in bone.

It is significant, nevertheless, that pseudofractures are always associated with conditions which weaken bone or in which bones are subjected to strains to which they are not adapted. It is significant, also, that those bones which are subjected to the greatest stresses are the ones most frequently involved. Leedham-Green and Golding stated that the process exhibits an elective affinity for the bones of the extremities. It would seem reasonable, however, to conclude that the frequency with which the lesions are found in the extremities is due to the fact that these bones are more subject to excessive strains than are those less frequently affected.

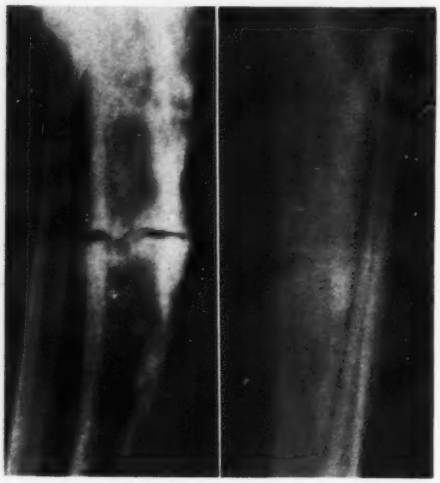

Fig. 9. Pseudofracture in the upper third of the tibia occurring in association with osteitis deformans (Paget's disease).

Certain authors have advanced the argument that the symmetrical distribution of the lesions would tend to show that excess strain is not an etiologic agent in their production. On the contrary, this appears to be an excellent explanation in favor of strain as a causative factor, since undue strain on a bone on one side of the body is sure to be exerted on the paired bone subjected to the same sort of activity. If, however, a bone which is affected by a weakening process and subjected to an undue load is compared to its normal fellow of the opposite side, bilateral pseudofractures will not be found.

Honigmann quoted Bier as having observed the development of these lesions in patients confined to casts, where the question of overload would seem to be eliminated. Even in such instances, however, it does not seem to us that overload can be ruled out, since muscular activity, movement of the patient, and slight movement within the cast are not eliminated entirely, and these may all play a part in subjecting a weakened bone to repeated minute traumas. Moreover, the lesions may have been initiated prior to application of the cast or splint without having been demonstrable at that time.

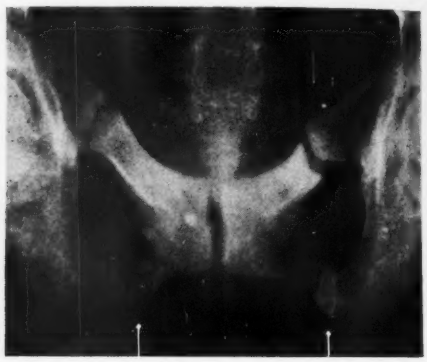

Fig. 10. Typical pseudofractures occurring in the pubis and ischium in a case of osteomalacia resulting from dietary insufficiency.

Localized areas of decalcification in the skull have been observed in several cases in which a widespread distribution of pseudofractures occurred (15, 37, 38, 54). It is probable that these lesions do not represent the same process as the pseudofractures, but may be manifestations of hyperparathyroidism. Such lesions show no evidence of fissure, crack, or cortical notching, nor is there any deposition of subperiosteal bone.

Jansen has pointed out that, up to a certain point of stress, pressure is capable of causing formation of bone, but that excessive pressure, beyond this point, leads to compression and possibly disappearance of bone. He has stated, further, that under excessive functional pressure bone loses its vital power of resisting that pressure and changes its nature, assuming plasticity.

It was Looser's belief that pseudofractures represented small local infractions in the bone due to mechanical irritation caused by deformity or excessive strain. He believed that the traumatic change which produced the local lesion was not a gross fracture, but rather the summation of small cracks which gradually divided the bone and to which the bone was particularly susceptible because of a generalized disease. This process may be compared, roughly, to the infractions caused in a piece of malleable metal by persistent bending back and forth (68, 79). Kugelmass and Berg have stated that in fracture the initial supply of calcium salts available for absorption by fibrinogen is obtained by the local production of amino acids which dissolve at least 20 per cent of the exposed ends of the bone. Jaffe (39) has discussed the local changes in hydrogen-ion concentration in relation to the resorption of bone in inflammatory conditions. He pointed out that, although the blood plasma and lymph are so well buffered that changes in the hydrogen-ion concentration are not easily produced, cellular metabolism occurs under conditions which suggest that different hydrogen-ion concentrations may exist in different portions of the same cell. Such increased local acidity may result in the production of narrow zones of either complete or partial decalcification in the vicinity of the vessels. He suggested that this local change in hydrogen-ion concentration might be due to local disturbances in the carbon dioxide tension, to local production of lactic acid, or locally to deficient oxidation.

It has been demonstrated by Ham, Tisdall, and Drake that, although apparent non-union was present in fractures in experimental animals suffering from artificially induced malacic disease, this was due entirely to lack of available mineral salts. It is likely, then, that the pseudofractures in malacic disease appear as wide bands of decalcification for this reason, although they were actually only minute cracks in the beginning.

The conception that pseudofractures do not represent a new disease entity, but that they are, indeed, partial fractures due to excessive strain, is further confirmed by the work of Sai, who was able to produce these lesions in experimental animals. He fastened the adjacent ribs of young guinea-pigs together and attached them to a weight, leaving them loaded in this manner against the animal's own respiratory movements. Pseudofractures were produced, not only in the loaded ribs, but in the neighboring ribs which had been sawed through so that they could move somewhat with respiration, but were still subjected to an unusual strain. Bittrolff, Elward, Fromme (23) and Müller (59) had previously noted that interference with one of two parallel bones sometimes led to pseudofractures in the other bone. Fromme discussed the changes observed by Müller, and mentioned similar cases which had been described by Martins and Bier, who called these lesions sympathetic pseudoarthroses and attributed them to the action of hormones. Müller was able to produce the lesions in the patellae of animals by maintaining forced flexion over long periods.

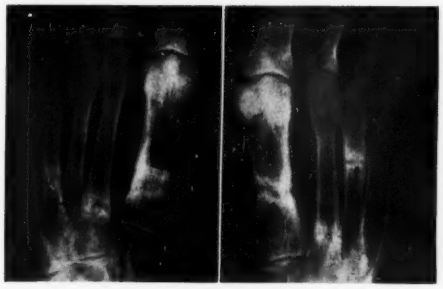

Fig. 11. Multiple pseudofractures in the metatarsals in a case of osteomalacia.

Sections of tissue taken from areas of

pseudofracture have been examined microscopically and have shown no definite pathologic picture which might be interpreted as typical of the condition. Michaëlis noted an absence of lamellar structure in the compact bone and an unusually rich small trabeculation in the haversian system. Honigmann found only an increased lacunar absorption and the development of a mesh-like bone without calcification. Gratsianskiy found nothing characteristic in the microscopic sections from his cases. Leedham-Green and Golding also stated that histologic investigation of the bone was of no help in the example they studied.

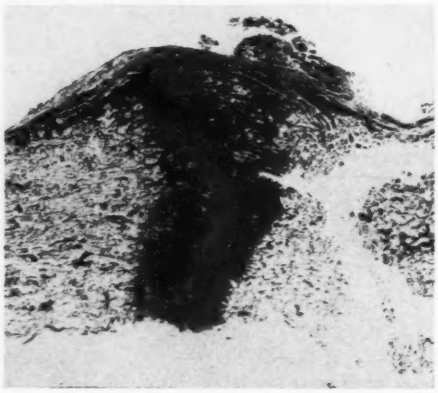

Fig. 12. Section of tissue removed from the zone of pseudofracture shown in Figure 6*b*, revealing an inactive type of bone. Osteoblasts are small and few in number. Osteoclasts are absent. There are a few marrow cells present, but most of the marrow consists of fat and fibrous tissue.

We have had an opportunity to examine bone biopsy material in three instances,[2] and our observations (Fig. 12) concur with those of Honigmann. The changes in the chemistry of the blood and urine are those of the associated skeletal disease, when such is present, and no alterations characteristic of pseudofractures have been detected (10). Chemical examination of a piece of bone taken at biopsy from an area of pseudofracture revealed the following values: organic matter, stated in per cent, 47.4; ash, 52.6; calcium, 36.7; magnesium, 0.67; phosphorus, 16.3.

There are no signs or symptoms which may be said to be characteristic of pseudofractures. The diagnosis is made roentgenographically. Pain appears to be the most common complaint, and may be a spontaneous ache or may be most noticeable when pressure is exerted over an affected area. There is generally a more or less severe degree of limitation of function, due in part to the pain elicited and in part to the subjective sensation of "giving-way" of the affected region. When the lower limbs and pelvis are involved, there is sometimes a waddling gait similar to that observed in congenital dislocation of the hip. The patient may have the greatest difficulty in climbing stairs or in rising from the sitting position, and may show a definite hesitation in beginning to walk when requested to do so. General weakness may be found in those severe cases in which the pseudofractures are associated with a generalized disease. The reflexes may be abnormal in certain cases, probably as a result of the disturbances in the blood chemistry, and there may be renal impairment consequent to the prolonged dysfunction of the calcium-phosphorus metabolism (15, 16, 21, 24, 27, 30, 33, 34, 36, 37, 47, 48, 54, 55, 60, 63, 71).

Treatment should be directed at correction of the associated disease if such is present. In malacic diseases without secondary hyperparathyroidism, for example, the exhibition of vitamin D concentrates and a diet adequate in calcium and phosphorus will result in healing of the lesions. In those cases in which excessive strain on the bone is the sole etiologic factor, proper immobilization of the affected part will produce healing as long as a normal calcium-phosphorus metabolism is maintained. Certain associated diseases, such as osteitis deformans or osteoporosis, are not completely understood and appear to run their own course. The avoidance of overstraining the affected bones will minimize the occurrence of pseudofractures. There is

[2] We are indebted to Dr. C. A. Stevenson of Temple, Texas, and to Dr. Louis A. Milkman, of Scranton, Penna., for their kindness in allowing us to study tissue sections from their patients.

some evidence to show that, in those cases of hyperparathyroidism in which the adenoma or hyperplastic tissue cannot be located surgically, a varying degree of amelioration of symptoms and regression of the bone lesions may be obtained by irradiation of the neck and upper mediastinal regions. The insertion of a massive bone graft across the area of pseudofracture is sometimes feasible and may result in healing of the lesion, as occurred in one instance in our own experience.

SUMMARY

A study of pseudofractures has been made in order to correlate some of the known facts concerning these lesions and to ascertain whether or not certain of them constitute a disease entity. An attempt has been made to explain the mechanism of the production of pseudofractures. The signs, symptoms, and treatment have been discussed briefly.

CONCLUSIONS

1. Pseudofractures may be found in association with a variety of conditions, not closely related, in which the bone is weakened.

2. The lesions may occur in apparently healthy bone which has been subjected to excessive strain.

3. They are incomplete fractures which may take several forms, depending on the associated pathologic condition, if such is present, and on the nature of the excessive strain to which the bone is subjected.

4. These lesions do not constitute a new disease entity.

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DISCUSSION

LOUIS A. MILKMAN, M.D. (Scranton, Penna.): Dr. Camp has pointed out a variety of different conditions, producing similar changes in the skeleton. In some the etiology is known and is definite. In others the etiology is unknown. How can we determine the relationship between the various bone diseases in the group he classifies as pseudofractures? The histology is not specific. Bone histology can indicate only bone absorption, bone deposition, or a combination of the two. There is no histologic technic that can demonstrate the dynamics of living bone.

Gleason published his famous monograph on rickets in 1650. This started a controversy that has been going on for nearly three hundred years and different pathologists have different criteria for the diagnosis of rickets and osteomalacia. In Kaufmann's *Pathology*, for example, "when the term osteomalacia is used, it is usually in the sense of an unknown general disease of the skeleton, particularly in certain parts of the world such as Lombardy, Cologne, Westphalia, East Flanders, etc." It is not the osteomalacia reported in India, China, or other parts of the globe. In other words, Kaufmann realized the confusion and defined the particular kind of osteomalacia with which he was acquainted. Puerperal osteomalacia is usually associated with pregnancy and lactation. Experimental osteomalacia can be produced in animals, but pathologists are not willing to agree that the changes are those of true osteomalacia.

Roentgenology is a valuable means for determining the extent of bone involvement and with serial roentgen examination living bone physiology can be studied. But this method also has its limitations. It cannot determine etiology.

As to chemical studies, at present they can determine the relationship between the various chemical components in bone or in the blood stream but cannot tell us how or why these components are deposited, or why they are abstracted from the skeletal system.

In the present state of our knowledge, therefore, we cannot use histology, chemistry, or roentgenology to group together a variety of bone lesions under the name of pseudofractures, for we must recognize the limitations of each of these methods. The etiology may be different, yet the roentgen appearance may be similar. A number of simple analogies occur to one. Thus fever may occur in many patients but in each may be a symptom of a different disease entity. Similarly a malignant tumor of bone causes bone destruction, but so also do infection and certain deficiency states.

As to the production of pseudofractures, bone is a living tissue that normally responds to stress and strain. That is its function. The fact that fractures occur in metal due to crystallization at the site of fracture, while by means of the electron microscope crystallization has been found

to occur at the site of pseudofractures, is an interesting observation, but here again the electron microscope cannot show what causes the crystallization. It is an end-result not a causative factor.

Dr. Camp and Dr. McCullough have grouped together osteomalacia, rickets, late rickets, renal rickets, celiac disease, chronic idiopathic steatorrhea, Gee's disease, non-tropical sprue, and sprue because they show pseudofractures, but that does not prove that they constitute a single disease. It merely shows the response of the skeletal system to unknown factors arising in a variety of prolonged disturbed metabolic states which in turn cause a deficiency of factors necessary for normal bone growth, or in the production of substances that are deleterious to bone metabolism. What these factors are is not known. They must be of a chemical nature controlled by a neurotrophic mechanism to enable us to explain the pattern of the skeletal disease, namely, its symmetry, its systemic distribution, and the characteristic transverse type of the fully developed lesion. Neither in the cases in the literature nor the case I originally reported, were there vertical fractures in the long, flat, or small bones.

I believe multiple spontaneous idiopathic symmetrical fractures to be a definite disease entity because they follow a particular pattern of bone destruction that is irreversible and classification with previously described entities has proved impossible on the basis of complete autopsy or histologic studies. The disease is to be differentiated from the following clinical entities:

Osteogenesis imperfecta is a congenital deficiency of the mesenchyme, occurring soon after birth.

Fragilitas ossium is familial in nature. It is a definite disease entity and was differentiated by Hess from rickets and osteomalacia, but not from multiple spontaneous idiopathic symmetrical fractures.

Hyperparathyroidism and *hyperthyroidism* can produce pseudofractures, but here again it is not clear whether these conditions occur independently, concurrently, or as the result of some deficiency or an attempt to eliminate some abnormal factor. Hyperparathyroidism, for example, has been found in renal rickets, the theory being that there is an attempt on the part of the organism to eliminate the increased blood phosphorus by combining it with calcium and that excessive parathyroid secretion is necessary to extract the calcium from the bone.

Osteitis deformans (Paget's disease) has been classed by many authors as generalized osteitis fibrosa, a disease definitely different from multiple spontaneous idiopathic symmetrical fractures.

Adrenal-pituitary bone dystrophy, hyperglycemia, and *severe chronic acidosis* have no etiologic or roentgen appearance that would normally classify them with multiple spontaneous idiopathic symmetrical fractures. They are due to a disturbance of endocrine function. The steps in the chemical change are unknown but the definite relationship to certain endocrine glands excludes them, and the bone changes are definitely late and secondary.

Congenital syphilis has been confused by the French with rickets for many years, but serologic tests rule it out.

Osteopetrosis is a form of fragilitas ossium and is radiologically, clinically, and pathologically different from multiple spontaneous idiopathic symmetrical fractures.

Osteomyelitis is a definite bone lesion that can be differentiated histologically.

March fractures occur usually in the feet. They are not systemic and may be a localized trophic condition.

Regarding the group of diseases reported from Germany and Austria in 1919–1920 as *hunger osteopathy, osteomalacia, rickets,* and *late rickets*, Hess says: "Circumstances were such in 1919 and 1920 that pathologic investigations of the lesions were few and unsatisfactory. As a result we are unable to classify the cases of this endemic either from an etiological or metabolic point of view. Also cases reported from Germany and Austria may not be the same." My review of the Austrian and German litera-

ture on this subject confirms Hess's impression.

In the case reported by Michaëlis, the pathologists, Schmorl, Pick, and Axhausen, found no evidence of fracture, infraction or regeneration zones. The above men certainly were aware of the cases reported in the German and Austrian literature.

During the past ten years many case reports corresponding to multiple spontaneous idiopathic symmetrical fractures have appeared in the literature and many of the authors agree that this condition is a definite clinical entity. Among these are dall'Acqua, Levi, and Bordoli; Garcin, Legrand, and Bernard; Guillain, Lereboullet, and Auzépy. Max Hopf (Bern) reports three cases (Radiol. clin. **9:** 74–88, March, 1940), expressing his agreement with Milkman as to the specificity of the disease and proposing to name it either morbus Milkman or dysbasia osteolytica dolens. There is a report of a case in the British literature; Dr. Karl Kornblum reported an example in Boston before the meeting of the American Roentgen Ray Society, and another case has been studied by Drs. Frederick Bost, Dudley W. Bennett, R. S. Stone, and A. M. Smith of the University of California.

JOHN D. CAMP, M.D. (*closing*): I am very happy indeed that Dr. Milkman was available to discuss this paper. It is not often possible to get the one who has pioneered in the investigation of an important subject to participate in a discussion such as this. Whether or not Dr. Milkman and I agree regarding the significance of this condition, and as to whether it represents a distinct clinical entity, makes little difference. The disagreement serves only to emphasize the problem which is presented by some of these malacic diseases of bone. If out of all this we can go home, work a little harder, learn a little more, and perhaps ultimately approach the solution, I shall feel well repaid.

EXCRETORY UROGRAPHY FOR CHILDREN[1]

INDICATIONS AND METHODS

By GEORGE M. WYATT, M.D., *Boston, Mass.*

From the Department of Roentgenology of The Infants' and The Children's Hospital, Boston

DISEASE of the urinary tract is a common cause of illness during early life, and is responsible for a significant number of deaths in this age group (3). Many of these patients may be benefited by surgery, particularly if urinary obstruction is present. Campbell (4) states that "various combinations of obstruction and infection constitute over 90 per cent of the major urologic problems in children."

It is obvious that early diagnosis is essential if surgical intervention is to be effective and that roentgen visualization of any anatomic abnormality is an important guide in the surgical approach. Of the two available roentgen methods, retrograde and descending urography, the latter has the following advantages: (1) It is a more physiologic method and is well adapted for visualization of mechanical obstructions provided the kidneys are capable of secreting the dye. (2) It is a safer and less complicated procedure than retrograde pyelography, which usually requires the use of a general anesthetic and often results in considerable trauma, even if a small cystoscope is used (9, 11).

Retrograde pyelography may be employed if indicated and physically possible. The conservative method of approach, however, is excretory urography, which with few exceptions should precede the use of instrumentation.

INDICATIONS FOR EXCRETORY UROGRAPHY

Pyuria, pain, and hematuria are the classical signs of urinary tract infection. They are frequently accompanied by fever, dysuria, frequency, enuresis, vomiting, diarrhea, or other systemic manifestations. Urinary tract infection is an indication for excretory urography with one possible exception, namely, a single acute attack of pyuria in a female child, with prompt response to therapy. Such infection in a male child should be thoroughly investigated because, although less common than in the female, it is more often associated with congenital malformations. Infection may not be detected unless urine examinations for pus cells and bacilli are done whenever unexplained fever is present. Chronic or recurrent infection always justifies urography regardless of sex.

Symptoms of urinary tract obstruction may be misleading if unassociated with infection. Obscure abdominal pain due to obstruction produced by congenital malformation may be the only finding. Such pain is often referred to the umbilicus or elsewhere in the abdomen. Persistent or recurrent vomiting may be the only indication of urinary tract obstruction. Any of these symptoms indicates the employment of urography when it cannot be explained on the basis of disease outside of the urinary tract.

Other indications for excretory urography are abdominal tumors, orthostatic albuminuria, and visible congenital malformations of the external genitalia.

PROBLEMS AND METHODS

Excretory urography during early life presents problems which are seldom met with in adults. Satisfactory urograms cannot be obtained unless these difficulties are overcome.

Gas in the small intestine is the most troublesome and confusing single obstacle to satisfactory pyelography in patients under the age of six or eight years. This is particularly true of infants. A small

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

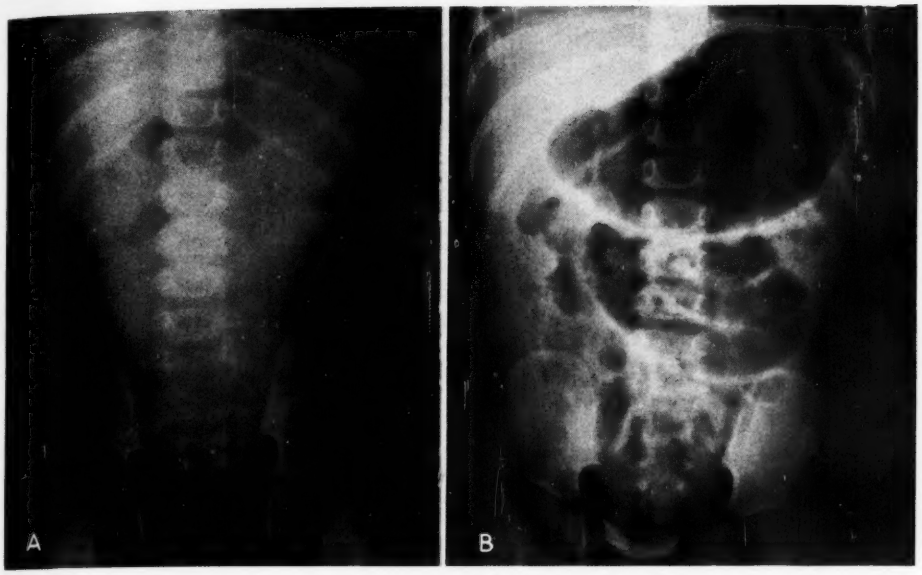

Fig. 1. Films showing the amount of air which may be swallowed, particularly if the patient cries, and the rapidity with which this air passes into the small intestine in the supine position. *A*. Preliminary film showing satisfactory preparation for urography. *B*. Same patient five minutes after dye was injected in the supine position.

amount of colonic gas is formed through fecal putrefaction, but the gas in the small intestine is derived largely from swallowed air which passes through the pylorus of the stomach. This occurs very rapidly in the younger patients if the air bubble in the stomach is allowed to come into contact with the pylorus (Fig. 1). The sole solution to the problem is to keep the air bubble away from the pylorus and this can be done only through posture (8). If the patient is maintained in such a position that the swallowed air may be expelled through the esophagus and cannot approach the pyloric end of the stomach, no air will pass into the small intestine.

Restraint is used only for infants who cannot sit or stand alone. The three optimum positions are *upright, prone* with the head slightly elevated, and *on the right side* (Fig. 2). Supine tilting of the body to an angle of 45 degrees is not sufficient because of the transverse position of the stomach during infancy (Fig. 5). Positions to be avoided are *supine* and *on the left side* (Fig. 3). Since air is always present in the stomach and is swallowed in large amounts if the infant cries, the two latter positions are to be avoided, even for an instant, over a period of at least twelve hours before the examination, though a shorter period may suffice (Fig. 4).

The most frequent lapses in postural technic occur during feeding, changing the clothes, transportation, injection of the dye, and taking of the films. As previously stated, any break in this technic almost invariably results in the passage of air from the stomach into the small intestine. Dependable and intelligent supervision on the part of those in charge of the patient before roentgen examination is essential.

Extremely small infants or very weak patients should be under close supervision while in the prone position because of the danger of asphyxiation due to inability to remove the face from the bed clothes or vomitus.

In older children, gas in the small intestine is not so great a problem. Patients who are able to stand alone have an opportunity to pass air from the stomach by

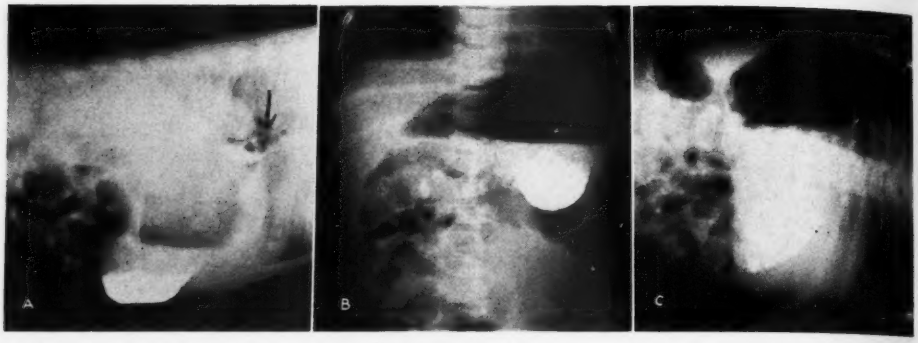

Fig. 2. Favorable positions for minimizing the amount of gas in the small intestine (age of patient four months). *A*. Prone. *B*. Erect. *C*. Left side up.
The stomach bubble may be expelled through the esophagus before it reaches the pylorus.

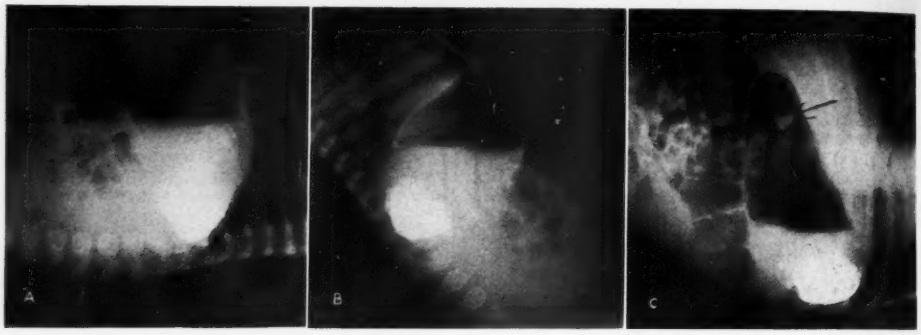

Fig. 3. Unfavorable positions which allow air to pass into the small intestine (age of patient four months). *A*. Supine. *B*. Supine with 45° tilt. *C*. Right side up.
The pylorus is more accessible to the stomach bubble than the esophagus in these positions. The 45° tilt may be effective in older children.

eructation. Even these patients, however, frequently cry and swallow excessive amounts of air during injection of the dye, and for this reason should be prone or on the right side during that procedure. Aside from this precaution, no preliminary postural preparation is necessary in older children. In general, the results are better if these small patients are not hampered in their normal activity.

Poor concentration of the urine is almost universal in children under one year of age, due to their large fluid intake. Restriction of fluids to the point of physical discomfort is inadvisable for all patients who are too young to understand why they cannot have a drink. Such patients manifest their discomfort by crying and, in so doing, swallow large amounts of air, which, in spite of precautions, often passes into the small intestine. Better results are obtained if no attempt is made to restrict fluids in very young patients. The lack of urine concentration is best compensated for by an increase in the amount of contrast material. Doses as high as 1 c.c. of diodrast per pound of body weight are necessary in the smaller infants. Fluids may be restricted in older patients as in adults.

Enemata frequently introduce more gas than is expelled, and have not been satisfactory in achieving good evacuation of either gas or feces. They have been dispensed with as a method of preparation for pyelography unless especially indicated.

Cathartics are beneficial in elimination of feces in children over two years of age, but have been found to increase the amount

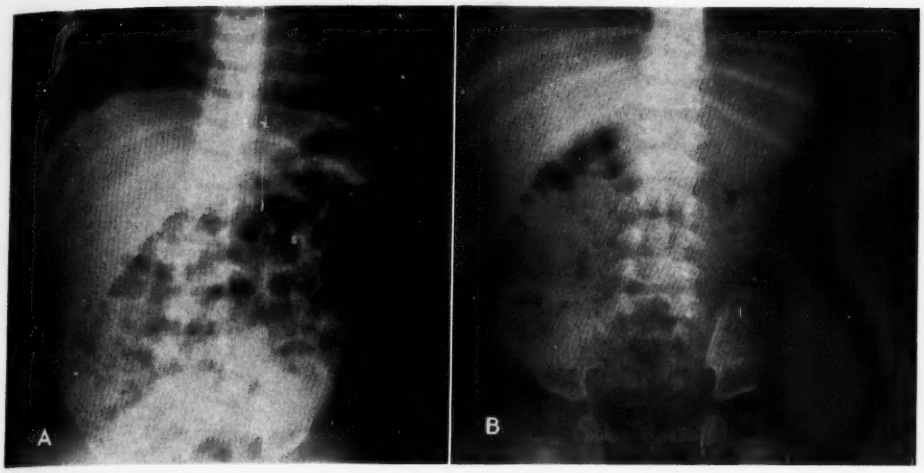

Fig. 4. *A*. Infant (L. M.), aged five months: Preliminary film showing unsatisfactory preparation for urography. Patient had been lying supine.
B. Repeat film after five hours in the prone position. The major portion of the gas has been absorbed or expelled from the intestines. A longer preparatory period, about twelve hours, is preferable.

of gas in the intestines in those patients who are as yet unable to stand alone. Any cathartic used in childhood should be mild. The use of castor oil is undesirable because it frequently leads to severe gastro-intestinal upsets. Compound licorice powder in effective dosage has proved to be the most satisfactory cathartic. There is great variability in the reactions of children to such drugs, however, and the cathartic should be prescribed by the referring physician who is familiar with the patient.

The measures used in preparation for excretory urography may be summarized as follows:

Infants who cannot sit or stand alone: (The preparatory technic in these patients is directed entirely toward minimizing small intestinal air and consists of maintaining postures which will allow eructation of swallowed air from the stomach).

Recommended postures are:

(*a*) Prone, with the head of the bed slightly elevated.
(*b*) Upright (when the baby is being fed or transported).
(*c*) On the right side. This position is the least desirable of the three, and should be used only if necessary.

Postures to be completely avoided are:

(*a*) Recumbent.
(*b*) On the left side.

(1) Preparation should start at the time of the last evening feeding before the morning of examination.

(2) There should be no break in the postural technic, even for an instant, from the time preparation is started until the x-ray examination is done the next morning. For this reason, the daily bath and weighing are omitted on the morning of the examination. Restraint should be used if necessary.

(3) Since crying causes ingestion of air, the infant should be kept as comfortable as possible, soiled diapers changed promptly, etc.

Children who can sit or stand alone:

(1) An effective cathartic the night before examination unless contraindicated. This is to be ordered by the patient's physician.

(2) Limitation of water and other fluids after 8:00 P.M. the night before examination, but no restriction to the point of causing the child to cry from thirst. Smaller children will require small quantities of water, whereas older children can go without any fluid by mouth from 8:00

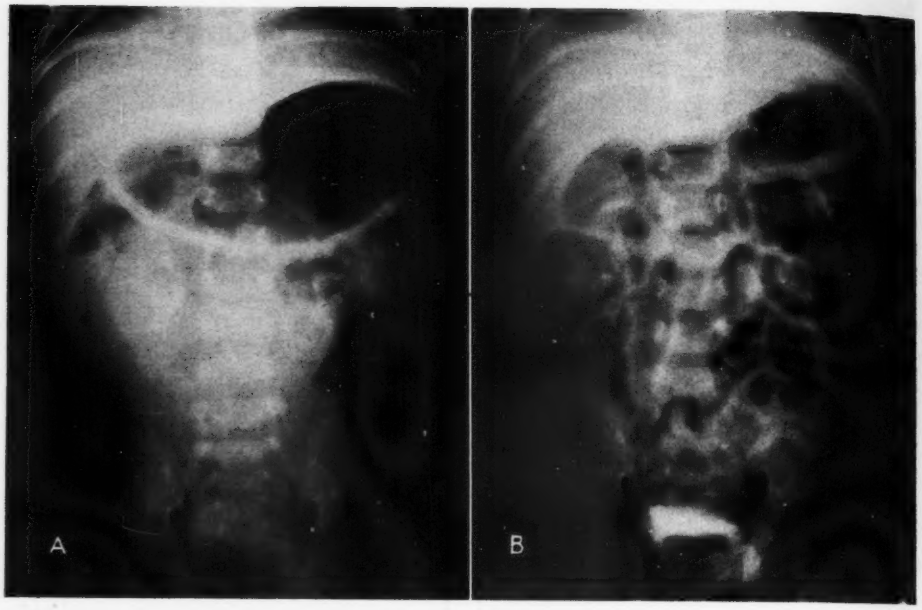

Fig. 5. *A*. Patient aged four weeks: Five-minute urogram taken in the supine position with the head tilted up 45°.
B. Same patient in the same position twenty-five minutes later. The 45° tilt is insufficient to allow the air in the stomach to pass through the esophagus. Note the transverse position of the stomach, which is characteristic during infancy.

P.M. until after the examination the next morning.

(3) Small breakfast consisting of one or two of the following foods: fruit, toast with butter, cereal with a small amount of cream, egg. Smaller children may have a few sips of milk or water.

(4) The child should be allowed normal activity and kept from crying if possible. Children usually swallow air when they cry and swallowed air interferes with the x-ray examination.

Pitressin has been used for elimination of gas and feces from the colon, and has proved very satisfactory in patients over the age of two years, dosage varying from 0.1 c.c. in patients of two years to 0.4 c.c. in those of twelve years (measured in a tuberculin syringe). Insertion of a rectal tube following administration of the pitressin improves the results. Less benefit has resulted from the use of pitressin in patients under the age of two years, chiefly because it does not aid in elimination of air from the small intestine. The usual contraindications for the use of pitressin must be kept in mind. Hypertension sometimes occurs secondary to urinary tract disease (2) even in very young children. The blood pressure should always be ascertained before administering pitressin, a procedure sometimes omitted in children. Pitressin is never given unless indicated by the findings on the preliminary film. Action is quite prompt in children, and the examination can usually be started about thirty minutes after injection of the drug.

Diodrast has been used in 1,021 examinations during the past two and one half years according to records kept over that period. It has been employed at The Infants' and The Children's Hospitals since 1934 without any fatalities attributable to its use, though fatal reactions have been reported in the literature (5, 6). Transient urticaria or edema has been observed in a few instances, but these reactions have not been sufficiently severe to warrant use of the adrenalin kit which is kept in the x-ray department. The usual contraindications

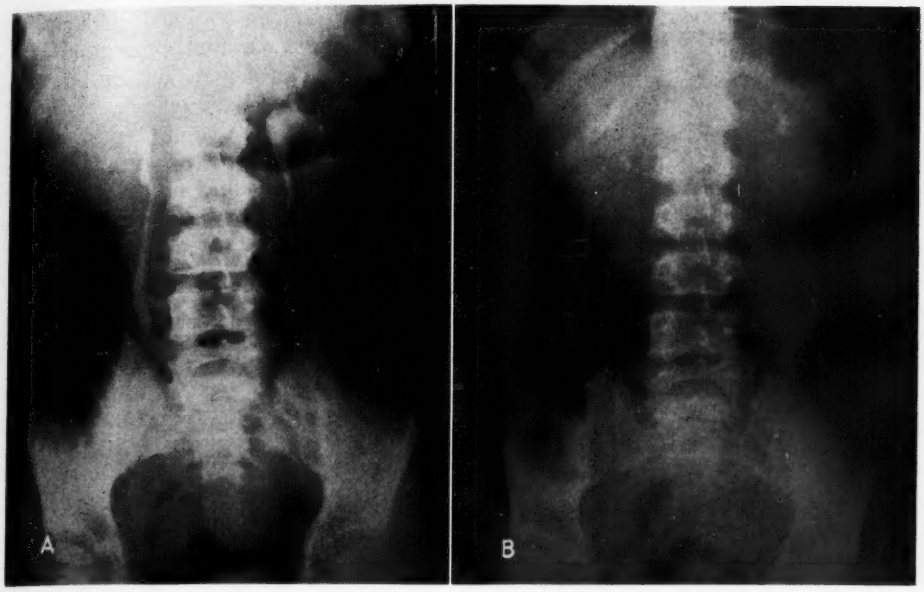

Fig. 6. *A*. Patient (W. H.) aged eleven and a half years: Normal recumbent urogram taken fifteen minutes after injection of the dye, showing fairly good visualization of the kidney pelves and portions of the ureters.

B. Urogram taken in the erect position immediately after the preceding, recumbent film. Very little dye is visible except in the calices. Such rapid drainage would not occur in the presence of obstruction.

to the use of diodrast have been observed. The use of the oral administration test may be of value in predetermining sensitivity (6). A history of allergy should lead to great caution in the administration of diodrast.

Relatively large amounts of diodrast have been found necessary in order to obtain good visualization of the urinary tract. Average doses are: 10 c.c. under six months of age; 15 c.c. between six months and two years; 20 c.c. between two and five years; 25 c.c. over five years of age.

The injection is made with the patient lying prone or on the right side. These positions render the technic more difficult than if the patient is held on the back but are necessary if the urinary tract is not to be obscured by swallowed air. A hypodermic needle is used because of the small size of the veins. The scalp veins are usually employed in the smaller patients, though any available vein may be utilized, including those on the dorsum of the hand and foot. Some form of swathing with a sheet or blanket is necessary for immobilization. A small amount of diodrast, usually 0.5 c.c., is injected, followed by a pause of one minute during which the patient is observed for any untoward reaction. If no reaction occurs, the remainder of the diodrast is given over a period of one to two minutes.

Diodrast may be injected subcutaneously in dilute solution according to reports in the literature, although this method has not been employed at The Children's Hospital. The procedure recommended is dilution of 20 c.c. of 35 per cent diodrast with 80 c.c. of normal saline to form 100 c.c. of solution; 50 c.c. of this solution is injected subcutaneously over each scapula, and the films are taken at intervals of ten, twenty, and thirty minutes (7).

Radiographic technic is similar to that employed in other examinations of small patients who cannot cooperate. The most important factors are patience and speed of exposure. Compression cannot be used

because of excessive struggling and fright. Various immobilizing devices have proved unsatisfactory or cumbersome, and have been discarded in favor of manual restraint by two persons who are not frequently exposed to irradiation. One person should hold the shoulders and the other the upper thighs to minimize the characteristic twisting movements of small infants. Several repositionings may be necessary before an exposure can be made. It is obvious that the films must be taken with sufficient rapidity to avoid blurring by motion. The most careful attention to other factors of technic is valueless if such blurring is present. The maximum time of exposure

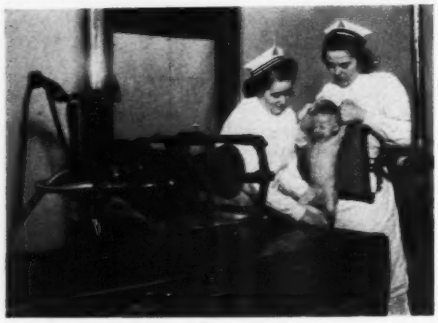

Fig. 7. Technic of holding infants for upright films of the urinary tract. Note that the child is supported by a hand under the gluteal folds.

Obviously, those who hold the patients must be persons not frequently exposed to irradiation. Immobilization is done by persons not frequently exposed to x-rays. The parents are used when possible.

should be one-tenth of a second. Average technic for a six-month infant calls for 65 kv., 200 ma., 1/20 sec., 36 inches target film distance, Lysholm grid. The Lysholm grid is used for all cases in which the Potter Bucky diaphragm cannot be employed. Speed is so important that if a sufficiently short exposure cannot be made at the usual target film distance, it is preferable to decrease the distance rather than increase the exposure time.

The *position of the patient* is varied to obtain a maximum amount of dye in the calices, pelves, and ureters with a minimum amount of gas in the small intestine. These two objectives are conflicting, in that the optimum position to avoid air is upright, whereas the maximum amount of dye is seen in the recumbent position (1). Urea excretion studies have revealed diminished kidney output in the erect position (13). This has been explained on the basis of diminished filtration (12). Comparison films taken in the upright and recumbent positions have repeatedly shown less dye in the kidney pelves and ureters in the erect position than seen in the recumbent films (Fig. 6) although this does not interfere with visualization of obstructions (10). The difference is not so marked in the calices, which may be well visualized in the erect position. For this reason, the first film is taken with the patient held upright if small intestinal gas is thought likely to occur (Fig. 7). If the calices are well visualized, subsequent films are taken with the patient recumbent. If there is dye in the bladder on the first film, subsequent films are taken with the patient recumbent. If, on the other hand, excretion of the dye is slow or there is evidence of obstruction, the patient is maintained in the upright position, although he may be placed prone between films. The last film is taken in the recumbent position to observe the mobility of the kidneys. Older patients are examined on a tilt table with the head of the table elevated about 30 degrees unless there is an excessive amount of air in the stomach on the preliminary film, in which case they are also taken upright. Thirty degrees elevation of the head is sufficient to keep a small gas bubble away from the pylorus in older children, whose stomachs have a more vertical position than found during infancy (Fig. 5).

Inspection of each film is obviously necessary to carry out the above technic, in addition to the need for such inspection if special views are to be taken for demonstration of anatomical abnormalities while the dye is still being excreted. Delayed interval films taken as long as three or four hours after injection of the dye may be indicated in patients with slow excretion or marked obstruction. Films are usually taken five, fifteen, and thirty minutes after

injection of the dye in order to obtain a standard for comparison of cases.

COMMENT

Early diagnosis of urinary tract disease in infants and children is essential for adequate treatment.

Excretory urography is a logical and in many instances the only roentgenologic approach to these problems.

The procedures which have been outlined have increased the value of excretory urography as a diagnostic procedure in the early age group at The Infants' and The Children's Hospitals. They are, of course, subject to change as experience suggests simpler or more effective methods.

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INTRAVENOUS UROGRAPHY IN THE UPRIGHT POSITION[1]

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THE study to be described was undertaken in an attempt to observe renal function under as nearly normal living conditions as possible. The group under consideration consisted of 19 persons—12 females and 7 males—all healthy and vigorous, with no urinary symptoms either past or present. Urine examinations previous to this experiment were reported as normal. The women were graduate or student nurses from the staff of the Kentucky Baptist Hospital; the men were students at the Medical School of the University of Louisville. In contrast to the usual method of intravenous study, no preparation was attempted, the women being examined in the morning just after the breakfast hour and the men in the afternoon just after the noonday meal.

The dye preparation used was diodrast; Du Pont films were employed. A preliminary five-minute film was made in the supine position, the dye being injected in the usual 30-c.c. dosage. Films were then taken in the upright position at twenty, thirty-five, and fifty minutes. Immediately after this last, another was taken in the supine position. To eliminate the respiratory factor all films were made in expiration. The technic was uniform for all cases: distance 28 inches; one second exposure; 100 ma.; kilovoltage varying with the size of the patient.

The first analysis of these films dealt with size and position of the kidneys. For this the five-minute films in the supine position were used. The first lumbar spine was bisected by a line across the film and used as a point of measurement; a parallel line drawn through the center of the kidney pelvis was used as the second point. In all but two of the kidneys the center of the pelvis was below the spine, the average distance on the right being 3.3 cm. and on the left 1.6 cm. In the men the distance measurements all fell within these averages but in the women the right kidneys were slightly lower. The average size of the right kidney was 13.5 × 6.1 cm., of the left 13.7 × 6.0 cm. It was found that the men had decidedly larger kidneys than the women—1.5 cm. longer and 1.0 cm. broader. This average, however, included one man who had a mild bilateral hydronephrosis with a right kidney measuring 17 × 6.5 cm. and a left measuring 16.0 × 7.0 cm., which raised the figure considerably. This case will be discussed later. In those cases in which ptosis was present any change in the length or width of the kidneys as they descended was considered an indication of rotation.

Before we can determine exactly what ptosis is, we are faced with the necessity of determining the normal not only as to position but as to size and shape as well. In these cases the average size was found to be 13.5 × 6.1 cm. for the right and 13.7 × 6.0 cm. for the left kidney, while the distance between the spinous process of the first lumbar vertebra and the middle of the right kidney was 3.3 cm., and of the left 1.6 cm. Of the 7 men studied, all fell within the normal limits for position as here indicated. Of the 12 women, 6 showed more than an average amount of excursion, 2 with ptosis on both sides and 4 with ptosis only on the right. In both the bilateral ptosis cases the right kidney at the point of fullest descent was one third within the bony pelvis. Here the lower poles rotated forward and inward, giving the characteristic droop to the pelvis with an approximate capacity increase of about 50 per cent. Slight foreshortening but no change in breadth was observed. The left kidneys maintained a uniform angulation with the spine and showed no

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, December 2–6, 1940.

increase in capacity; one showed a coiling of the upper third of the ureter without dilatation. The 4 cases with right-sided ptosis showed no angulation, increase in capacity, or dilatation of the ureters, but in one, with an excursion of 9 cm., there was an elongated S-shaped coiling of the upper third of the ureter when at the point of lowest descent.

In none of the subjects was there any interference with mobility of the kidneys. Even in those with the greatest excursion the kidneys slid upward into normal position with apparent ease. The amount of excursion was determined from a comparison of the kidneys in the five-minute plate taken in the supine position and the fifteen-minute plate in the upright position. The minimal descent considered as a ptosis was 5 cm. and the maximal 9 cm. The pelves were well outlined in all the five-minute films taken in the supine position and could be considered normal as to shape and infundibular and caliceal markings except in one instance. This was the man with a bilateral hydronephrosis, with extra-renal pelves, short thin infundibula, and narrow calices but with ureters normal in size and course and no apparent basis for the pelvic dilatation.

When these findings are considered from a roentgenologic standpoint, 7 of the 19 persons examined, or 36.8 per cent, were found to have gross abnormalities: one man with bilateral hydronephrosis, 2 women with bilateral ptosis and angulation, and 4 women with ptosis limited to the right side. This is a somewhat greater percentage than is usually recognized. It is difficult to fit the clinical picture of supposedly normal urinary tracts with these x-ray findings. In the case of the man with bilateral hydronephrosis the ureters can be ruled out with comparative safety. They are of normal caliber throughout their length and the pelves were found to empty satisfactorily in the later films. There is no ptosis in this case, the right kidney does not change its position at all, and the left moves downward only 1.0 cm. The centers of the pelves, however, lie 5.0 and 4.5 cm. below the first lumbar spine. The kidneys are large, especially in length, but the outline is smooth and the function is excellent if we may judge accurately by the output of intravenous pyelographic dye. This young man is twenty-four years of age and so far has had no symptoms referable to the upper urinary tract, though later he may be found to have bilateral polycystic disease.

The plates taken at five minutes in the supine position show that in the patients with ptosis the kidneys lie lower than the average, 1.2 cm. on the right and 0.4 cm. on the left. They are somewhat larger, also, than the average size for the women. With the exception of the two kidneys which enter the bony pelvis, and so rotate slightly on their longitudinal axes, there is no apparent increase in pelvic capacity or evidence of obstruction or back pressure, but in two cases there is a definite coiling or kinking of the upper segment of the ureters. In these cases, too, it is hard to reconcile the absence of clinical findings and the presence of x-ray abnormalities and to determine, without symptoms or pathologic evidence in the urine, what advice, if any, should be given these women? Without exception they are hard at work daily and have the usual amount of outdoor exercise and recreation and are apparently in good condition.

When we consider these ptoses from a clinical point of view, however, the answers are more readily found. As we know, with the exception of gonorrhea, urinary infections are much more frequent in women than in men. It is the exception rather than the rule for a woman to reach middle life without having had treatment for urinary infection at one time or another, either based upon actual evidence or symptoms implying a pathological process. In the child-bearing period these infections are decidedly more serious and are consequently seen more frequently and are investigated more thoroughly by the general practitioner or obstetrician and thus come to the attention of the urologist. About 20 per

cent of all pregnant women have a more or less serious attack of pyelitis sometime during their pregnancy. Even in those women having kidneys normal in every way the physiological changes which occur during gestation, especially hypertrophy, elongation, and dilatation of the ureters, are apt to be predisposing factors toward later infection. What increase in this tendency can be expected in the 50 per cent of our group with ptosis of the kidneys and coiling of the ureters? It seems almost certain that these conditions will have a great deal of bearing upon the occurrence of later infection, as well as upon the type and extent of treatment necessary. We do not believe, however, that just because there is x-ray evidence, as found in these cases, even of extensive ptosis, operative interference should be advised. Nevertheless, these are the patients who will eventually undergo suspension of the kidneys or plastic operation about the pelvis, and a large percentage of them may later show tendency toward stone formation especially should infection intervene.

The explanation of ptosis in these women is not clear. All the factors which theoretically combine to keep the kidneys in so-called normal position were present so far as we could determine. With the exception of one woman, who was only three pounds underweight, all were well nourished, slightly on the fat side if this is to be considered; all were healthy and there was no evidence of aberration of blood supply or of a general tendency toward ptosis as shown by the abdominal viscera. Interabdominal pressure should have been present normally also. Therefore we can simply state the fact, without offering any explanation, that 50 per cent of the normal women examined showed ptosis.

In conducting this experiment a uniformly good and equal secretion of dye was found. Both kidney pelves filled promptly and were well shown on the five-minute films. The ureters were well outlined and showed only those variations normally found and expected in this type of examination. Usually the upper thirds were quite well filled and distinct, and in an average number the ureters could be seen for their entire length. There occurred a normal amount of constriction due to peristalsis. When films were taken in the upright position, differences were evident at once from comparable time plates taken in the supine position. There was distinctly less dye in the pelves than one would expect, except in the two women whose right kidneys entered the bony pelvis. In these there was a retention. The ureter outlines were lost entirely and, although the bladders filled with dye in the usual fashion, the ureters were not seen after the five-minute films until the supine position was again assumed. These findings would seem to be explained best on a basis of an increase in pelvic and ureteral contractions (peristalsis) and therefore would indicate the presence of an increase in excretory function in the upright position.

In the majority of the fifty-minute upright films, little dye could be seen except in the bladder. The calices were spotty, the pelves shown poorly and the ureters hardly at all. Kidney shadows were normal. When the supine position was assumed at fifty minutes rather surprising amounts of dye were found. It is true that the dye was not as dense or the outlines as distinct as in the five-minute films, but the improvement over the fifty-minute upright plate was marked. This fact can be explained on a physical rather than a physiological basis, probably by a more uniform distribution of intervening viscera, muscular thickness or tension, and a more uniform approximation to the plate. These factors, too, may explain the clearer plates obtained after the application of the distended bag sometimes used to obtain better ureteral definition. In short, we feel that secretion and excretion were normal and influenced by factors not usually found in the ordinary method used in intravenous pyelography.

This experiment must be criticized in

several ways. Nineteen cases are hardly a large enough number to form the basis of a statistical study and for that reason we do not assume to prove facts but only to indicate tendencies from which some conclusions may be drawn. A weight-height survey of these cases was not made before examination—the data were obtained from physical examination records made upon entrance to training together with health records during the training period. From the definition of these plates we feel that preparation for intravenous urography may not always be an essential. Lack of preparation more nearly approaches normal conditions, and we found no increase in elimination of the dye and no more than the usual amount of intestinal gas or solid contents—two reasons usually given for preparation. Taking into account the fact that we were using asymptomatic subjects, it is probable that in a person suffering pain or upper urinary tract irritation there might be an increase in the amount of accumulated gas as a result of reflex action. There is a definite loss of ureteral definition in the upright position so that interpretation is more difficult, this being the most serious objection. In several cases of ureteral stricture with dilatation above, the ureters are as well if not better outlined in the upright than they are in the supine position. As in any variation from an accepted procedure of examination, many cases and many observers must be considered before conclusions can be drawn.

In summary, intravenous urography was studied on 19 normal subjects: 7 men and 12 women. The technic was uniform and there was no preliminary preparation. X-ray evidence showed that of the men 14.3 per cent and of the women 50 per cent had abnormal kidneys. There was one case of bilateral hydronephrosis with enlarged kidneys, two cases of bilateral ptosis with accompanying pelvic dilatation, and four cases of ptosis limited to the right side. The lack of preparation did not interfere with the ease of reading the plates. In the upright position there was more than the usual loss of definition in the calices, pelves and ureters, but the kidney and bladder shadows were well outlined. This loss of definition is explained on the basis of an increase of peristaltic activity in the upright position, a probable change or shifting of the intra-abdominal contents, and a loss of good approximation to the plate. With return to the supine position definition is greatly improved. This is explained by a simple reversal of factors.

Because of the small number of cases studied no conclusions should be drawn, but we feel that this study indicates that there is a higher percentage of kidney abnormalities than usually believed, that x-ray evidence alone should not be the basis for surgical interference, but that these abnormalities should be considered to be the predisposing factor in later infections and possibly stone formation.

DISCUSSION

EDGAR C. BAKER, M.D. (Youngstown, Ohio): Dr. Wyatt's paper on excretory urography for children illustrates the extreme care that must be used technically for any special procedure. It is my hope that he will have no use for the adrenalin kit. In connection with intravenous diodrast, I do feel that anyone has a much more wholesome respect for this type of work if he has had experience with a severe reaction. We at present are testing all of our patients before the dye is administered and believe that this should always be done.

Personal experience in a relatively small number of examinations of children would lead to the conclusion that retrograde pyelography is indicated fully as often as intravenous. It is certainly no less safe than intravenous and is at times necessary to disclose pathology. We have not seen the considerable trauma with this procedure which Dr. Wyatt mentions. Certainly papers which describe the technic meticulously, as his does, are helpful.

The paper by Dr. Bowen and Dr. Shiflett on pyelography in the upright position brings to our consideration a recapitulation of certain anatomic factors which are too often overlooked. In an effort to compare individuals regarded as normal with those in whom a pyelographic study was indicated, we measured seventeen females. The pyelograms had been made within the last year and both supine and upright films were available. The measurements were made as nearly as possible as Dr. Bowen described in his paper. According to his figures, the average size of the right kidney was 13.5 by 6.1 cm. In our cases the average was 12.8 by 5.4 cm. The left kidney in his series averaged 13.7 by 6.0 centimeters; in our series 12.8 by 5.6 centimeters.

One striking thing was immediately seen on the study of the figures in our series. Ptosis seemingly had nothing to do with pathology. In other words, if there was a band or an aberrant vessel in the region of the junction, a drop of 3 cm. might cause trouble. If no such band was present, a drop of 6 or 7 cm. produced no dilatation and no definite evidence of pathology in the urinary tract.

In approximately one-third of our cases we found that the descent exceeded the 5 cm. which Dr. Bowen and Dr. Shiflett regard as minimal for the consideration of ptosis. I think the exact measurement makes little difference and we prefer to size up the patient and the amount of descent rather than to determine upon any fixed distance. The problem of ptosis, in our opinion, is a constitutional matter rather than a problem dealing with any single organ.

We believe that the infection of which Dr. Bowen speaks, in pregnancy, is due much more frequently to pathology in the bladder or urethra, or to adnexal disease, than to actual pyelitis. We doubt whether his patients with ptosis of the kidney will have any greater incidence of infection during childbirth than others. The obstructive phenomena in pregnancy are due largely to obstruction at the pelvic brim by the pregnant uterus, and this factor could not be evaluated from a purely renal study.

It is a common experience for us to find that pyelograms taken in the upright position show pelves and calices which empty very rapidly unless obstructive pathology has been found. The factor of gravity would seem to be an obvious explanation. Even with the use of serial pyelograms we have never demonstrated any evidence of increased peristalsis or increased activity in the upright position.

We certainly agree that the ideal preparation for an intravenous examination, in an ambulant patient, is no preparation at all. In conclusion, we feel that Dr. Bowen and Dr. Shiflett have added very definitely to our anatomical knowledge. We would question, however, whether any pathologic inferences can be drawn from this knowledge.

KARL KORNBLUM, M.D. (Philadelphia, Pa.): I feel that Dr. Wyatt is to be congratulated on his presentation, and his emphasis upon technic. We all appreciate the difficulty of examining infants, particularly by intravenous urography. It is a difficult problem and Dr. Wyatt has gone into it thoroughly giving us something very practical to carry home with us.

As to the paper of Dr. Bowen and Dr. Shiflett, I am surprised that so much is being made of examination in the erect position, which I thought was a routine urographic procedure.

I am convinced that the incidence of ptosis, if one wishes to call it such, is much higher than 50 per cent. I would put it somewhere around 90 per cent. In other words, a certain amount of descent of the kidneys is a normal finding, and of itself means nothing. If it is not producing any pathology, it can simply be disregarded.

I was also surprised at the explanations offered for the fact that the urinary tract is not as well visualized in the erect as in the recumbent position. We have routinely made films, one after another, first

in the recumbent and then in the erect position, and have immediately observed a decrease in the amount of dye in the kidney pelvis and ureter of normal subjects in the erect position. I am convinced that gravity is really the responsible factor for this rather than increased or decreased excretion.

GEORGE M. WYATT, M.D. (*closing*): Gravity and muscular contraction may well play a part in causing a smaller amount of contrast medium to be seen in the erect than in the recumbent position. I brought out the factor of diminished kidney function in the erect position because that is the only pertinent phase of the problem which, to my knowledge, has been carefully studied by the physiologists. The "why" is not so important, however, as is the fact that obstruction can be seen as well in the erect as in the recumbent subject. As to the difficulty of examining infants, infinite patience is probably the first requirement for dealing with these small patients in any type of radiologic procedure.

We have not used cutaneous or oral diodrast sensitivity tests because we have not been sure that they were effective indicators of the type of sensitivity that might cause a fatal reaction. Our test has consisted of injection of a minute quantity of contrast medium followed by a pause of one minute before giving the full dose.

Retrograde pyelograms are indicated in many of even the smallest patients. One might say that if urographic study is indicated, the patient should be examined by every method available. I believe that the excretory method is the first approach to the problem. Patients will submit much more readily to this method than to the instrumentation and frequent anesthesia of retrograde urography. More pathologic changes, consequently, will be detected earlier if the excretory rather than the retrograde method is recommended first.

One point which should be emphasized regarding cystoscopy is the experience of the operator. A clever cystoscopist can safely examine a very small patient, but one who is unaccustomed to handling children may do a great deal of harm.

The use of adsorbents for decreasing intestinal gas has been suggested, but we have not tried them because we did not believe they would have any appreciable effect on the large quantities of air which are frequently swallowed.

J. ANDREW BOWEN, M.D. (*closing*): As I indicated in reading my paper, I did not draw any definite, hidebound conclusions, and I am very glad that certain points have been questioned.

As to the choice between physiology and gravity as an explanation for the fact that pyelograms taken in the upright position are less distinct, I think that this depends upon one's point of view. Probably both factors play a part.

In a group of experiments now being conducted at Louisville, we have an illustration of this argument, in a very acute form. There was a surgeon by the name of Hendon, who some years ago indicated that negative pressure applied through a catheter in the bladder would increase the rate of output of urine. This, I think, may be compared to gravity. And along this line experiments are now being carried out on dogs. It has been found that slight increases of negative pressure thus applied very definitely increase the urinary output.

The argument is now in full swing and the work will be reported within the next six months.[1] This may or may not be a good comparison, but it appears to me as such.

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ROENTGENOLOGY OF RENAL TUBERCULOSIS[1]

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THERE is very little in the medical literature of the past five years which has added much to our fundamental knowledge concerning the diagnosis and treatment of renal tuberculosis. Although one of us, in many communications, has repeatedly stressed the importance of bilateral pyelograms in the diagnosis of the early lesions of the disease, this method of examination has not obtained its rightful place of importance. Few published papers have mentioned the retrograde pyelogram as revealing findings that are of great diagnostic importance, while many articles contain discussions about the value of excretory urography. As late as 1937 a world-renowned European surgeon published an article in which he condemned the ascending pyelogram as rarely necessary. In his opinion the diagnosis of renal tuberculosis can be made by ureteral catheterization and the finding of pus cells and bacilli of tuberculosis in the catheterized urine.

The present paper is in the nature of a review of the diagnostic and treatment data of renal tuberculosis from the roentgenologic point of view. We shall reiterate and emphasize salient clinical features and stress the relationship which always exists between the roentgenologic data and the clinical findings.

We have had an unusual opportunity to study renal tuberculosis in a private clinic practice in a large metropolitan area, and in a 700-bed county sanatorium[2] which admits patients with all types of tuberculosis. At the end of the last statistical year, 7,700 patients had had examinations of their urine or of their urogenital tracts by one of us in our attempt to find early lesions of renal tuberculosis. Of 4,199 patients from this group whose records were complete, 4.1 per cent had a clinical or postmortem diagnosis of lesions of tuberculosis in one or both kidneys.

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

[2] Glen Lake Sanatorium of Hennepin County, Oak Terrace, Minnesota.

INVASION STAGE

During the invasion stage, renal tuberculosis, in the majority of instances, consists of the hematogenous implantation of bacilli of tuberculosis in both kidneys, so that a complete urological examination must determine accurately the presence or absence of pathological changes in each. In the attainment of this objective, roentgenologic examination of the kidneys, including pyelograms, yields information exceeded in value only by the cytologic and bacteriologic data obtained from catheterized ureteral urine specimens, collected with the proper precautions. The pyelographic shadows may not be sufficient for a positive diagnosis, although in 27 per cent of cases, filling defects in the profile shadow of the renal pelvis are the only findings suggesting renal tuberculosis.

In all cases the urologist and roentgenologist must study and evaluate all the data obtained from a complete urologic examination before they offer a diagnosis. In doubtful cases, when the renal pelvis is not well filled with an opaque solution and a poor outline shadow results, or when small filling defects are present, repeated urologic and roentgen examinations must be made.

Plain Roentgenogram.—The plain roentgenogram of the kidney areas is of little or no value in the diagnosis of early lesions of renal tuberculosis. In 25 per cent of long-standing or advanced cases it may give valuable information. Enlargement and irregularity of the kidney shadows are

common. Shadows produced by calcifications in the anatomical areas occupied by the kidneys occur commonly, and these may be divided into three types:

(1) Minute single or multiple shadows varying in density and shape, occurring in areas occupied by the renal parenchyma. These shadows may at times be confused with renal calculi, although calculi do not often develop in the renal parenchyma.

(2) Large, irregular, shadows coral-shaped and of different densities, involving a large portion of the renal area.

(3) Shadows produced by the so-called "mortar kidney," which consists chiefly of loculated and more or less homogeneous calcified caseous débris. This type of shadow is produced almost exclusively by an autonephrectomized kidney.

Careful examination of the scout films of the kidney areas may reveal soft tissue shadows of abscesses that are secondary to bone lesions and shadows of pathologic changes in the bones of the spine and pelvis.

Relationship of Bone and Joint Tuberculosis to Renal Tuberculosis.—Ten per cent of our patients who have tuberculous lesions of the bones and joints, demonstrable by x-rays, have concurrent lesions of tuberculosis in the kidneys. Bacilli of tuberculosis may spread to all tissues and structures in the human body concurrently. The association of tuberculous lesions in the bones and joints and in the kidneys is the most frequent among the combinations of lesions indicative of spread of the infection *via* the blood stream from the primary focus in the chest cavity.

Excretory or Intravenous Urography.—Excretory urography is being employed frequently in the diagnosis of all lesions of renal tuberculosis by many of the leading clinics of the country, although much difference of opinion exists concerning its place in diagnosis in the *early stages* of the disease.

Emmett and Braasch made an analysis of 100 cases of tuberculosis of the kidney in which excretory urography was employed. It was used by them not to establish the presence of the disease but to determine the degree of involvement in each kidney.

This method of examination has many advantages, one of which is the ease with which the urogram can be made. Frequently excretory urography can be employed successfully when the ureters cannot be catheterized and when the patient refuses cystoscopy and retrograde pyelography. Excretory urography also furnishes valuable information to supplement that obtained by retrograde pyelography. The most common findings observed by Emmett and Braasch are, in order of frequency: (1) no visualization; (2) delayed visualization; (3) caliectasis; (4) evidence of necrosis in the outline of the calices and areas of parenchymal destruction; (5) cicatricial deformity of calices and "pinching off" of tips of minor calices or their obliteration; (6) deformity or dilatation of the ureters; (7) pyelectasis.

When the above urographic findings occur, a provisional diagnosis of renal tuberculosis can be made. When they are supplemented by data obtained from studies of the urine, a positive diagnosis may be made. Conversely, however, one cannot state positively on the basis of an excretory urogram that a kidney is free of tuberculosis. About 40 per cent of kidneys whose pelves reveal no deformity on the excretory urogram will eliminate tubercle bacilli which may be found if the urinary sediment is stained or injected into guinea-pigs.

Some writers regard excretory urography as a synchronous record of the anatomy and functional capacity of the kidneys. They believe that tuberculous lesions produce reduced function and decreased ability of the involved kidney to concentrate, findings which are of diagnostic importance. These observations may be true when large areas of the kidney or kidneys are involved, but no diminution of function or ability to concentrate has been observed by us when dealing with early or small lesions of renal tuberculosis.

There are a few disadvantages associated with excretory urography in the diagnosis

of renal tuberculosis. Preparation of the patient is difficult, especially in the presence of tuberculous enteritis, which is a contraindication to drastic catharsis. The intestines of patients who are constantly confined to bed are filled with gas, which cannot be removed easily. A diseased kidney may have little or no function, so that excretion of the shadow-casting solutions is slow and concentration slight; in such cases little information can be obtained regarding the type or extent of disease that may be present.

Intravenous or excretory urograms fail to give sufficient definition and filling to delineate small papillary ulcers or parenchymal abscesses. They also lack detail and sharpness. To recognize the early destructive lesions of renal tuberculosis one must visualize small deformities of minor calices on the film.

We employ the plain roentgenogram routinely and use the excretory urogram to supplement and not to replace retrograde pyelography.

Bilateral Pyelography.—The importance of well filled bilateral pyelograms in the diagnosis of early lesions of renal tuberculosis has not been correctly evaluated either by urologists or roentgenologists. Pyelograms that reveal a normal outline with no filling defects will exclude lesions of renal tuberculosis in 90 per cent of the cases.

A complete urologic study involves cystoscopic examination plus the cytologic and bacteriologic study of urine specimens obtained by ureteral catheterization. Since catheterization of the ureters must be performed in each case, the injection of opaque media through the catheters into the kidney pelves entails very little additional trauma. Bilateral well filled pyelograms are accurate portrayals of the type and extent of disease present in each kidney, and enable the urologist and roentgenologist to determine and employ the proper medical or surgical treatment.

Doctor Miley Wesson, in his book "Urological Roentgenology," writes that well filled bilateral pyelograms may be the only method of arriving at a correct decision in (*a*) the diagnosis of early lesions in circumscribed areas; (*b*) in diagnosing tuberculous lesions confined to one kidney, when the guinea-pig test of the urine from the other side is positive; (*c*) in the differentiation of ureterectasis secondary to ascending ureteritis and that occurring from pyelonephritis; (*d*) in identification of doubtful renal shadows; (*e*) in differentiation of pyelonephritis and tuberculosis; (*f*) in ascertaining the cause of a few pus cells from a supposedly normal kidney.

The lesions of renal tuberculosis may be grouped clinically, on the basis of well filled pyelograms, into two categories: non-destructive and destructive. The non-destructive type presents a normal pyelogram on repeated examinations, but bacilli of tuberculosis are found during one or more urinalyses. In this type a lesion is present somewhere in the kidney but it does not communicate with the calices and pelvis. A renal tubercle may heal or may progress and become a "destructive lesion" opening into a calyx, under which circumstance it can be detected on the pyelogram. We emphasize the need for repeated urologic examinations including bilateral pyelograms in such cases.

Occasionally the well filled renal pelvis shadow may not reveal filling defects suggestive of renal tuberculosis while the ureteral shadow may have the typical "beaded" outline which is diagnostic of ureteral involvement secondary to a primary lesion in the kidney.

The *earliest destructive lesion* demonstrable on the pyelogram is the *papillary ulcer.* The pyelogram shows a tiny "moth-eaten" area of destruction or filling defect at the tip of one or more calices. The recognition and the interpretation of small lesions of this character cannot be made unless they are repeatedly visualized on the pyelogram. If the tiny filling defect is constantly present on all films, either with or without changes in its size or character, a lesion of renal tuberculosis is probably present. If

bacilli of tuberculosis are found in the urine, the diagnosis is positive.

While we cannot prove conclusively that destructive lesions heal, we have several cases in which the clinical and roentgenologic data indicate probable cure. Proof of cure will depend upon the pathologic examination of postmortem specimens not yet obtained. The progress in the destruction of tissue in all early lesions of renal tuberculosis is usually slow. We are able to observe changes in the outline shadows of filling defects when serial pyelograms are obtained at regular intervals.

PARENCHYMAL ABSCESS

Parenchymal abscesses are small areas of destruction in the parenchyma of the kidney connected directly with calices. Such lesions are larger than the papillary ulcer and may be the result of continuing destruction in this area. These abscesses vary in size and number. Evidence of increase in size means progress in the destructive effect of bacilli of tuberculosis. The outline of these lesions is irregular and has been described as "moth-eaten" in character. If these parenchymal abscesses develop from an ulcerative area, they appear as excavations at the calyx tips. If they originate in the parenchyma and then open into the renal pelvis, the excavation and the pelvis are connected by a narrow area of destruction which may open and close and be visualized on the pyelogram at one time and not at another.

Some small parenchymal abscesses do not progress in size; others become quiescent and cease to eliminate bacilli of tuberculosis. Usually destructive lesions of any size in the renal parenchyma will progress to destruction of that kidney. Sometimes, however, they may be walled off from the renal pelvis and the rest of the kidney so that pus cells and tubercle bacilli are not found in the urine. Evidence of complete healing with the deposit of calcium has occurred in certain areas of the kidney without complete destruction.

All of these *deformities* of the renal pelvis and parenchyma and the changes which may occur in their character may be visualized on films if the renal pelves are completely injected with shadow-casting solutions by the retrograde method.

Frequent visualization of the outlines of the renal pelvis and the filling defects that may be present is necessary when the abscess is small and medical treatment is being employed, when bilateral involvement is present, and when other conditions are not optimal for surgical treatment.

ADVANCED LESIONS OF RENAL TUBERCULOSIS

The roentgenologic, urologic, and clinical findings in advanced renal tuberculosis with large parenchymal abscesses, pyonephrosis, and ureteral involvement, are familiar to all roentgenologists and need no discussion here.

POSTOPERATIVE RENAL SINUSES

Following the surgical removal of one kidney, breakdown of the wound or a chronic draining sinus may develop. The roentgenogram of the renal area after the injection of a thick opaque suspension under moderate pressure will reveal the extent and ramifications of such a tuberculous sinus. The location of the shadows on the film is valuable to the surgeon during surgical treatment of this condition.

RENAL LESIONS AS LOCAL MANIFESTATIONS OF A GENERAL DISEASE

Although the roentgenologist is an important member of the clinical team responsible for the diagnosis of pulmonary lesions of tuberculosis, he, like many other specialists, is likely to forget that *any extrapulmonary lesion* of tuberculosis is a manifestation of spread of the bacilli *via* the blood stream from the chest cavity to other organs and tissues of the human body. We would emphasize the fact that *lesions of renal tuberculosis are local manifestations of a constitutional disease.* When a focus of tuberculosis is discovered in the kidney, other foci should be sought, especially in the chest, bones, and joints. Only when a correct diagnosis of the extent

of the disease is made, can proper therapy be recommended.

CONCLUSIONS

1. The plain film of the renal areas is valuable only in advanced cases of renal tuberculosis.

2. The presence of osseous tuberculosis should suggest to the roentgenologist that a renal lesion may be present.

3. Excretory urography should supplement rather than replace retrograde pyelography in the diagnosis of renal tuberculosis.

4. Bilateral pyelograms of well filled renal pelves are essential in the diagnosis of renal tuberculosis and in differentiating the type of lesion present.

5. Serial pyelograms enable the urologist and roentgenologist to determine the progress of renal tuberculosis, the type of treatment to be prescribed, and the changes in methods of treatment which will best serve the particular patient under consideration.

6. The presence and extent of sinus tracts occurring in the renal areas following surgical removal of a kidney may be visualized on a film if the tract is carefully filled with some opaque suspension.

7. Lesions of tuberculosis in the kidney are local manifestations of a general disease, which is the result of the spread of bacilli *via* the blood stream.

DISCUSSION

KARL KORNBLUM, M.D. (Philadelphia, Pa.): Dr. Thomas could not have brought his plea for the early diagnosis of renal tuberculosis to a more suitable audience than one of radiologists, because of the great importance of roentgen investigation in all manner of urological conditions.

For the diagnosis of early renal tuberculosis, Dr. Thomas has emphasized the value of bilateral retrograde pyelography.

It is surprising how our ideas change with increasing knowledge of the underlying pathology of any given disease. I have a distinct impression that some ten or fifteen years ago an authoritative statement was made, and accepted, that retrograde pyelography should never be done if the diagnosis of tuberculosis of the urinary tract could be made by any other method. This attitude, I believe, was due to fear of spreading the infection from one kidney to the other. Now we know, as Dr. Thomas has stated, that in the majority of instances the infection is bilateral from the very onset. I gather from his remarks that retrograde pyelography is definitely not contraindicated in renal tuberculosis.

Furthermore, bilateral pyelography was formerly considered an ill-advised procedure in any case, on the basis that a reflex anuria might occur on both sides with a fatal result. I have long since given up this idea and I am glad to note that Dr. Thomas obviously feels the same way about it.

There are certain things that Dr Thomas has refrained from saying, which I am going to take the liberty to say for him, because I think they are essential to really put across a point that he has brought to us to-day.

The increasing popularity of excretory urography, since its introduction in this country in 1930, has produced a tendency on the part of many clinicians to attempt a short-cut to the diagnosis of urinary tract conditions. The first reaction of many clinicians who have patients with urologic symptoms is to send them to a roentgenologist for intravenous urography. This is not always to the patient's best advantage. If the examination shows evidence of pathology, the case, of course, is referred to the urologist. If, on the other hand, the result of the examination is negative, the clinician is all too prone to regard this as bona fide evidence that no disease exists in the urinary tract.

Only the urologist and the roentgenologist, I feel sure, appreciate the limitations of excretory urography. Dr. Thomas has emphasized the inadequacy of intravenous urography in the early diagnosis of renal

tuberculosis; with this idea I am in full accord. I believe that when it is possible to make a diagnosis of renal tuberculosis by intravenous urography, the lesion is no longer an early one. I feel certain, however, that if Dr. Thomas and his urologic colleagues will teach the radiologist the pathology of early renal tuberculosis and particularly the symptomatology and clinical manifestations at this stage of the disease, we can do a great deal toward rendering his plea for early diagnosis a success. We cannot, of course, refuse to accept for intravenous urography patients who are referred to us, but if we are more tuberculosis conscious, if we are more intimately acquainted with the early symptoms of renal tuberculosis, then in the presence of a slightly suspicious intravenous urogram, or even one which is entirely negative, we can at least suggest to the clinician that tuberculosis should be considered as a possible diagnosis.

Especially is this true, as Dr. Thomas has emphasized, in the presence of tuberculosis elsewhere in the body, as the chest or the bones.

I should like to add my plea to that of Dr. Thomas, that the radiologist give more attention to this subject. As I have already mentioned, the increasing use of intravenous urography has placed a great responsibility upon our shoulders. If we are going to assume that responsibility, we must prepare ourselves, and to prepare ourselves, we must study urology. Furthermore, I feel that we can render a real service by using our influence in seeing that the urologic patient gets into the proper hands, that is, in the hands of the urologist.

GILBERT J. THOMAS, M.D. (*closing*): Dr. Kornblum presented an excellent discussion, for which I thank him.

Many clinicians, urologists, and roentgenologists claim that they do not see patients with early lesions of tuberculosis in the kidneys, *i.e.*, those appearing as tiny filling defects on the pyelogram. This statement is correct. I see them in a tuberculosis sanatorium where all patients have some form of tuberculosis, usually a lesion in the chest cavity. The physician does see patients, however, who come to the office or clinic with lesions of tuberculosis in the bones or joints. If these observers interpret the pathology of general tuberculosis correctly, they will recognize these lesions as manifestations of spread of the disease from the chest cavity, associated in about 11 per cent of the cases with renal lesions.

The patient with early renal tuberculosis has no urinary symptoms. The symptoms of cystitis are secondary to bladder involvement from lesions of primary tuberculosis in the kidney. If then no observable symptoms are present, the urologist must examine the urine and make pyelograms of patients who have any lesions of tuberculosis.

The roentgenologist can render a great service if he keeps these important points in mind: Spread of tuberculosis from the chest cavity means that it is a general disease. It may spread to the kidneys in about 4.1 per cent of cases.

IRRADIATION IN DERMATOLOGY[1]

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ROENTGEN rays and radium have been used for the treatment of skin diseases for over forty years. During this time many different technics have been employed and even to-day there is a lack of uniformity in the application of radiation. In many instances there is little or no justification for using widely different technics for the same condition. Formerly x-rays and radium were used empirically, but now their administration is based on sound physical and clinical data. Generally speaking, when radiologists treat skin diseases with x-rays or radium they tend to employ higher voltages, greater filtration, larger doses, and shorter intervals between treatments. Dermatologists, on the other hand, employ lower voltages, little or no filtration, and smaller doses with longer intervals between treatments. In many cases the total dose applied for the treatment of any individual lesion is about the same.

Since the object of treatment is to cure or ameliorate cutaneous affections without leaving radiation sequelae, it is desirable that a more uniform technic be employed. I do not hold that there is one best method of applying x-rays and radium for the treatment of any given disease. Dosage must of necessity be elastic within certain limits. A more uniform dosage may, however, yield better therapeutic results, with greater safety to the patient. This desired technic can come to realization if all those utilizing x-rays and radium for the treatment of skin disease base their dosage on the correlation of physical and clinical data. Under physical data are included quality and quantity of radiations, size of field, frequency of application, rate of application, and method—intensive or fractional. Under clinical data are included radiosensitivity, the depth and nature of the pathologic process, its location and extent—generalized or localized. The entire problem of correlating physical and clinical data in radiation therapy has been so ably and adequately discussed by Meyer (1) that any attempt on my part to elaborate on this subject would be superfluous.

It should be emphasized, however, that the type of pathologic process under treatment should be the deciding factor in regard to the quality of radiation to be employed. From the standpoint of therapeutic response, most writers agree that hard rays as well as soft will bring about resolution of a given cutaneous lesion. Nevertheless, hard radiations are unnecessary and may prove to be dangerous to important underlying structures. In treating a superficial lesion with hard rays, a greater total number of roentgens may be administered since the erythemal response is less than with soft rays. The number of roentgens required to produce an erythema (2, 3) with low-voltage unfiltered x-rays is 300–350, while with high-voltage heavily filtered x-rays up to 700 r may be necessary. For temporary epilation, a dose of 300 to 350 r is required for soft radiations and slightly higher for harder radiations. It certainly is more desirable to use that quality of ray which gives the optimal result with the smallest number of roentgens and the slightest danger to underlying structures.

Even now with our present knowledge of radiology and tissue response, we still adhere to methods of treatment laid down many years ago. When we speak of unfiltered low-voltage radiation for the treatment of cutaneous lesions we have in mind

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

radiations generated with 80 to 100 kv. Yet absorption curves and clinical experience indicate that for superficial lesions 50 kv. are as effectual as 100 kv.

ABSORPTION DATA

The skin in its thickest portion is not more than 1 cm. thick. The basal cell layer may reach a depth of 1 mm. In most instances it is only 0.5 mm. in thickness. Many of the inflammatory lesions are in this zone. Sebaceous glands may reach to a depth of 1.5 mm., while hair follicles may be 3 mm. deep. The sweat glands are at about the level of the third or fourth mm. and the adipose tissue is at about or below this level. Most cutaneous pathologic processes, therefore, take place within the first 3 mm. of tissue, though the figures of course vary, depending upon age, sex, and the area from which the skin is removed. Skin from the palm and sole, for example, is much thicker than that over the nose. Also inflammation, edema, parakeratosis and hyperkeratosis, cellular proliferation, and other pathologic processes alter the above dimensions.

Our interest is mainly in the skin and it will be seen to what degree radiations of 10 to 140 kv. peak are absorbed in successive millimeters of skin. Figure 1 shows the actual depth measurements of the various radiations used in dermatology superimposed with correct dimensions over a cross-sectional diagram of the skin.[2]

Grenz rays (10 kv.) are absorbed for the most part in the first 0.5 mm. of skin. After penetrating the horny layer (approximately 0.2 mm.) only about 70 per cent of the surface intensity is measurable, and by the time the ray traverses 1 mm. of skin, only 15 per cent. Grenz rays are thus seen to be ineffectual for the routine treatment of cutaneous lesions, since they are incapable of penetrating to the sites where pathology is most frequently found. If very large doses are given and repeated often and over a long period of time, clinical improvement may ensue as a result of a small portion of a very large surface dose reaching a sufficient depth to affect the pathologic process. This surface overdosage, however, may cause radiodermatitis (telangiectasia, atrophy, pigmentation and depigmentation).

So far as I know, American dermatologists now seldom use grenz rays. They are of very limited value. They may be useful in treating recurring lesions of eczema or psoriasis in hairy parts such as the scalp, eyebrows, and bearded area, as with their use the danger of the permanent loss of hair is minimized. They are valuable, also, for the treatment of lesions on the scrotum, where x-rays may have some deleterious effect on spermatogenesis. Grenz ray therapy for eyelid lesions is preferable to roentgen irradiation, since it minimizes the danger to the ocular structures. Wise (5) and others have noted improvement in cases of Darier's disease treated with grenz rays, in which x-rays as commonly used by dermatologists were without effect. Some are of the opinion that grenz rays are of particular value in treating cutaneous cancer, vascular nevi (port wine marks, angioma), and other skin disorders, while a number go so far as to state that they are safer and just as useful as x-rays in treating skin diseases in general. This is not my opinion. There has been no unequivocal evidence to indicate that grenz rays are indispensable or that they have practical advantages over low-voltage x-rays for the treatment of cutaneous affections.

Radiations of 40 and 100 kv. peak show differences of absorption at a depth of 1 mm. of only 5 per cent. At this level, radiations generated with 100 kv. show 17 per cent absorption and with 40 kv. 22 per cent absorption. The response of lesions situated 1 mm. below the surface should be about the same to radiations generated with 40 and 100 kv. At a depth of 3 mm. the difference in absorption is 10 per cent; at 6 mm. the absorption with 100 kv. is 52 per cent and with 40 kv. 68 per cent, a difference of 16 per cent.

[2] The figure and data on absorption curves are taken from an article by Mutscheller and the author (4).

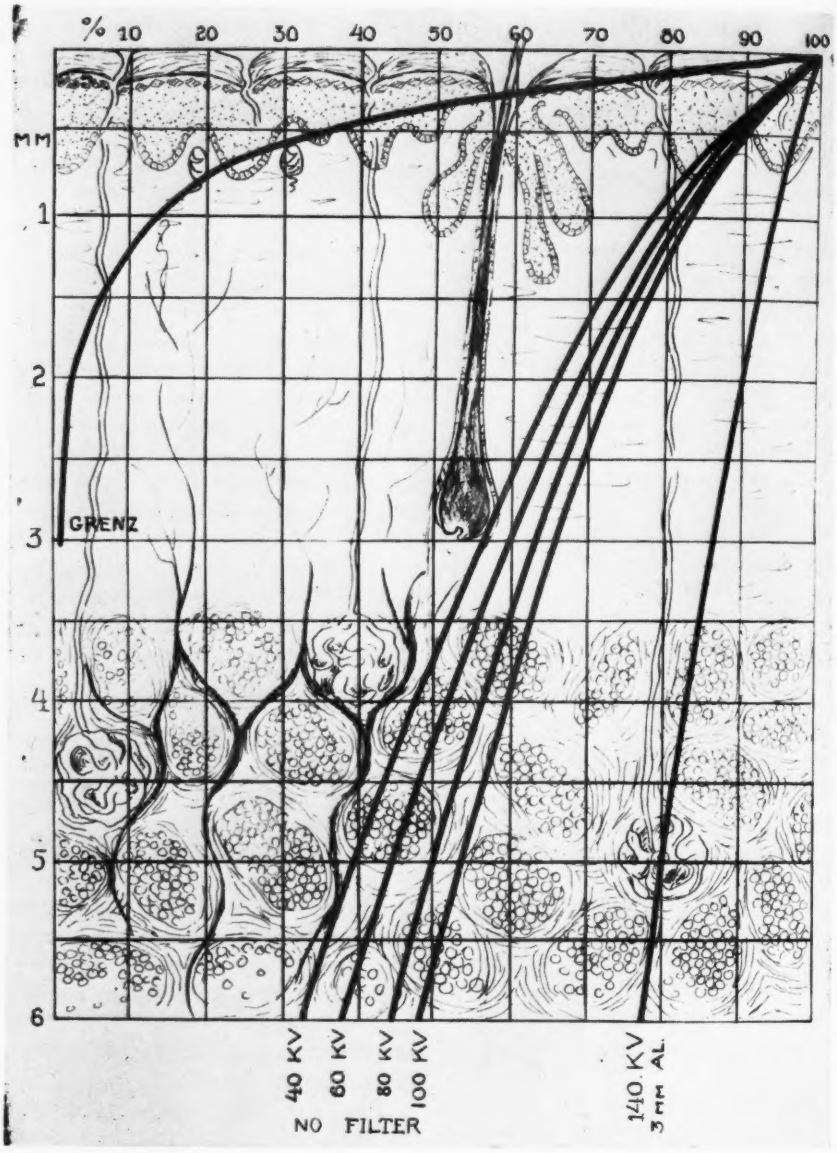

Fig. 1. Absorption curves showing depth doses of various radiations used in dermatologic practice superimposed with correct dimensions over a cross-sectional diagram of the skin. The measurements were made in air with a Victoreen iontoquantimeter. The apparatus used was a mechanical rectifier with a universal type Coolidge tube. The peak voltages varied from 40 to 140, the milliamperage from 3 to 5; the skin focal distance was 50 cm. and the portal 3 by 3 cm. For measurements with 10 kv. a Westinghouse air-cooled tube grenz ray apparatus was used. Special chambers were constructed for the iontoquantimeter. (From CIPOLLARO, A. C., and MUTSCHELLER, A.: Absorption of Roentgen Rays by the Skin. Arch. Dermat. & Syph. **41**: 87–95, 1940).

These findings lend support to the hypothesis that for routine dermatologic roentgen therapy, unfiltered x-rays generated with 40 kv. should be as effective as those generated with 100 kv. Certainly 100 kv. roentgen rays are more than adequate to

reach the usual sites of cutaneous pathologic processes. If for routine dermatologic roentgen therapy x-rays generated with 50 kv. are utilized, there may result uniformity of technic and dosage, greater safety, and lower cost of equipment. Various dermatoses, including superficial basal-cell epitheliomas, have been treated with unfiltered x-rays (mechanical rectified apparatus, Coolidge tube, 50 to 100 kv.); also with 50 kv. and 2 mm. aluminum filter and with 140 kv. and from 0.5 to 3 mm. aluminum filter. The therapeutic response was about the same with the different voltages.

Radiations generated with 140 kv. peak and filtered through 3 mm. aluminum are very penetrating. At the 2-mm. level there is an absorption of only 10 per cent of the incident beam. At a depth of 6 mm., the absorption is only 22 per cent and before 50 per cent of the incident beam is absorbed a thickness of 20.5 mm. of tissue is required. Obviously, for routine dermatologic therapy, this hard radiation is more than is required. Many new x-ray machines have an inherent filtration which is equivalent to 2 mm. aluminum. This is undesirable, as it makes it necessary to administer to superficial lesions harder radiations and a larger number of roentgens than are necessary.

It would be superfluous and repetitious to attempt to describe the technic to be employed for the treatment of the many dermatoses that are amenable to radiation. Textbooks and numerous articles written by dermatologists and radiologists adequately cover this ground. However, the discussion of some special phases of a few diseases commonly treated with x-rays may help in clarifying some disputed points.

ACNE VULGARIS

Probably the most common skin disease treated with x-rays is acne vulgaris. There is no one cause in any given case, but in most instances there is a probable hormonal imbalance. The pathology is that of a chronic inflammation involving the pilosebaceous apparatus of boys and girls about the age of puberty. The extent of the pathologic process at its greatest depth is probably no more than 3.0 mm. from the skin surface. Since there is no specific cause, and since the success of treatment depends upon the partial inhibition of pilosebaceous activity, the best single and most practical method of treatment as shown by clinical experience is roentgen irradiation. I do not want to convey the impression that all cases of acne vulgaris should be routinely treated with x-rays. Most dermatologists use x-rays only after other methods have failed. The percentage of permanent cures may be increased by employing with radiation such measures as attention to face, scalp, and general hygiene, exercise, removal of focal infections, correction of diet and constipation, treatment of secondary anemia, institution of therapy with staphylococcus toxoid, arsenic and glandular products, and the application of mild local remedies including "acne surgery."

Dermatologists usually employ x-rays generated with about 100 kv. without filtration. A dose of about 75 r is administered at weekly intervals. The total dose varies with each case. Between 600 and 1200 r are given over a period of three to six months to each affected area. Among those who employ the above technic are MacKee (6), Andrews (7), Ormsby (8), and Wile (9).

Many radiologists with whom I have discussed details of technic in the treatment of skin diseases employ medium-voltage filtered x-rays (140–175 kv. and 2 to 4 mm. aluminum). There are some radiologists, however, who are in complete accord with the practice of the dermatologists. Desjardins (10) says: "For skin diseases, unfiltered rays or rays filtered through 2 mm. of aluminum and generated at 80 to 100 kilovolts are generally preferable."

DERMATOPHYTOSIS

Dermatophytosis is of frequent occurrence, and the most common causative

organism is *Trichophyton interdigitale*. The disease most often affects the spaces between the toes or the soles, but may also involve the hands, groin, and axillae. Sometimes it may be generalized. Since ordinary acute cases of dermatophytosis respond extremely well to topical remedies, roentgen rays should not be used routinely. What the physiologic effect of radiation is on fungous affections is not clear, since the quantity required to destroy cultures is extremely high. Not all cases respond, but those that do, do so after small amounts of low-voltage unfiltered x-rays.

Two to six treatments of 75 r each, at weekly intervals, with low-voltage unfiltered x-rays are generally sufficient for dermatophytosis of the hands and feet. Along with radiation therapy the application of soothing and mildly antiseptic remedies helps to hasten involution.

Dermatophytosis is an infection and recurrences are common. Frequent repetition of courses of x-rays may lead to undesirable sequelae. Those radiologists who advocate the use of x-rays filtered through 4 mm. aluminum, a kilovoltage of 140, and a dosage of 150 to 200 r at weekly intervals, for from four to six weeks, are using more and harder rays than are necessary. I believe that the danger of radiodermatitis is increased by the employment of this technic and dosage.

NEURODERMATITIS

Neurodermatitis is of two distinct types —circumscribed and disseminated. The most common form of localized neurodermatitis is that which occurs in women, on the back of the neck just within the hairline. The disseminated type may begin in infancy and is more appropriately called atopic eczema. It affects the flexures of the elbows, knees, and sides of the neck, and in some cases may be generalized. From most patients a family or personal history of asthma or hay fever may be elicited. At times the pruritus is intolerable, and the disease may last for many years. Radiation, therefore, should be given with extreme caution and only to allay the most severe form of the disease. At no one time should the full tolerance dose of x-rays be applied to the involved areas because of the risk of over-radiation.

In treating neurodermatitis x-rays are used mainly for their antipruritic effect. As the itching subsides, the cutaneous lesions also improve. Each dose consists of 75 r of low-voltage unfiltered x-rays given at weekly intervals for about four treatments. Even though neurodermatitis responds well to radiation, it may recur within a few weeks after treatment. The tendency to repeat courses and to increase dosage is great; the danger of irradiation sequelae is therefore a real one. When the eruption is generalized, x-rays should be applied to only a portion of the body at a time. One-third to one-fourth of the body is covered at one sitting and within one week the entire body surface is irradiated. Four rounds constitute a course of treatment. When large surfaces are irradiated, less than 75 r are administered to each area. Repeated blood counts should be performed. If the eyelids, scrotum, and hairy parts are affected, grenz rays may be employed if available; otherwise radiations obtained with the lowest voltages and without filtration should be used. Even with low-voltage x-rays, the eyeballs and testicles should be adequately protected.

PSORIASIS

Psoriasis is easily diagnosed by most physicians. The etiology is unknown. Some patients with psoriasis remain permanently free of lesions after they have been treated with x-rays. Most patients, however, experience recurrences. Like neurodermatitis, psoriasis is characterized by frequent recurrences and by its persistence for many years. Extreme caution must therefore be used to prevent radiodermatitis. Lane (11) says that he has "probably seen more cases of post-radiation scarring, atrophy, and telangiectasia in psoriasis than in any other single disease."

The method of treating psoriasis with x-rays is definitely not the one of choice.

It has been observed that some cases show no improvement whatever after irradiation. The acute lesions of short duration respond much better than does inveterate psoriasis. The best clinical results are obtained when x-rays are applied directly to the lesions. A dose of 75 r of low-voltage unfiltered x-rays may be given at weekly intervals for a total of from four to six treatments. When the eruption is extensive, one-fourth of the body is exposed at each sitting. This process is repeated each week until from four to six complete rounds are given. For generalized cases it is recommended that no more than 40 r be administered to each fourth of the body once a week. For lesions affecting the eyelids, scrotum, and scalp, grenz rays should be substituted for x-rays.

In some cases a full erythema dose of x-rays may bring about a better temporary result than the smaller dose, but the risk of radiodermatitis is much increased. In treating such benign conditions as psoriasis, meticulous care should be taken to avoid radiation sequelae. MacKee (6) states (p. 517) that at a meeting of the New York Dermatological Society the members agreed that in recurrent diseases like psoriasis x-rays are not to be employed as a routine and their administration should be entrusted only to one who knows the disease and its characteristics. They also agreed that when properly employed, in selected cases, roentgen therapy is safe, efficacious, and a clean method of obtaining relief from disagreeable objective symptoms and in gaining control of the disease.

Occasionally when areas of psoriasis disappear, white patches (leucoderma psoriaticum) remain. These eventually disappear but they may persist for a long time. They have nothing whatever to do with irradiation. When psoriasis affects the nails, the disease is much more stubborn and one must not continue to administer x-rays up to the point of clinical improvement. It is not safe to apply more than six treatments to the nails in any one year.

Good results have been claimed by Brock (12), Otto and Harry Foerster (13), Jamieson (14), and others in treating psoriasis by irradiating the region of the thymus. The factors used were 140–200 kv., 3 mm. of aluminum to 0.5 mm. of copper, 125–200 r per week, skin focal distance of 30–40 cm. and a portal of 10 × 10 cm., anteriorly and posteriorly. Some, including Kaplan (15), have obtained good results by irradiating the spinal area. High-voltage (200 kv.) x-rays were used, filtered with 0.5 mm. copper and 1 mm. aluminum, through portals of 10 × 15 cm. directly over the cervical and upper and lower dorsal and lumbar vertebrae. A total of 150 r was given to each area at weekly intervals for four treatments. My own experiences do not coincide with some of those reported in the literature. Most dermatologists do not employ this indirect method of treating psoriasis.

MYCOSIS FUNGOIDES

Mycosis fungoides is difficult to classify. It belongs probably to the lymphoblastomas and has some relationship to Hodgkin's disease, lymphosarcoma, and leukemia. In addition to cutaneous lesions, there may also be adenopathy resembling Hodgkin's disease. Occasionally tumors develop in the lungs, bones, tongue, and mucous membranes of the gastro-intestinal tract. The hemogram is usually normal.

Mycosis fungoides may be generalized or localized. In some instances the disease resembles generalized eczema, parapsoriasis, disseminated neurodermatitis, leprosy, and certain drug eruptions. Pruritus is usually intense. The individual lesions vary in size, are dusky red, scaly, and infiltrated. The contour is circular or semicircular and sometimes the lesions form rings within rings. In some instances the tumors ulcerate and form large fungating masses. Occasionally tumors regress spontaneously.

The disease is incurable but under x-ray therapy the patient may be made comfortable and life may be prolonged for many years. There is considerable difference of opinion regarding the technic to

be employed in the treatment of mycosis fungoides. Most dermatologists prefer frequently repeated small doses of unfiltered low-voltage x-rays applied directly to the lesions. Since most tumors of mycosis fungoides are very sensitive to x-rays, massive doses of high-voltage, heavily filtered radiations are unnecessary. Occasionally a lesion fails to respond to unfiltered x-rays but does regress when treated with filtered x-rays. Some radiologists radiate the long bones, spleen, liver, and lymph node-bearing areas in the hope of influencing the cutaneous lesions of mycosis fungoides. It has been my experience that this method of treatment has little or no effect upon the disease. When mycosis fungoides is properly treated with roentgen rays startling results are observed. Patients in poor general health, covered with intensely pruritic lesions, are frequently relieved within a few weeks with very little radiation. Even large ulcerating and fungating lesions disappear promptly.

No definite plan of treatment can be outlined for mycosis fungoides since each patient responds differently. Even different lesions in the same individual behave differently. After irradiation, patients may remain well from several weeks to several months or years. Recurrences are as radiosensitive as the original lesions. Some patients require several courses each year and others only an occasional treatment to keep the disease under control. When the eruption is generalized, the body area is divided into four parts and each part is treated once a week, up to a total of three to six weeks. When there are only a few discrete lesions the affected portions are irradiated with 75 r of unfiltered low-voltage x-rays at weekly intervals, the blood count being checked frequently. Even thick and fungating lesions respond well to these small doses of unfiltered low-voltage rays. Arsenotherapy is efficacious occasionally and it may be used alone or in combination with roentgen rays. Lesions occurring in the gastro-intestinal tract, lungs, bones, and lymph nodes, are best treated with medium- to high-voltage (140–200 kv.) x-rays, filtered with 0.5 to 2 mm. of copper. The exact factors to be employed depend upon the depth and location of the lesion to be treated. The dosage is from 400 to 600 r delivered in divided doses over a period of two to four weeks. This is certainly one disease that would cause death soon after its appearance were it not for x-rays.

VERRUCAE

Since warts are benign lesions, a quantity of radiation sufficient to cause sequelae should not be given. Doses of twelve to twenty times that required to produce an erythema are unjustifiable. It is difficult to understand the cures and the failures when verrucae are exposed to radiation. Some warts respond to a single erythema dose of unfiltered x-rays. Others resist even twenty times that amount given either in divided doses or at one sitting. I generally administer to a verruca vulgaris, closely shielded with lead foil or lead rubber, a dose of 300 r of unfiltered low-voltage x-rays at one sitting. If there is no improvement at the end of the month, a second dose of 600 r is administered. Destruction with electrosurgery is resorted to if the lesion resists this amount of radiation.

Plantar warts are often painful, and surgical or electrosurgical procedures may incapacitate the patient. Whenever possible it is desirable to use radiation. After paring the thickened horny layer with a razor or scalpel, an erythema dose (300 r) of low-voltage unfiltered x-rays is applied to the closely shielded lesion. At the end of one month the patient is examined and if there has been no effect upon the verruca, a second dose, of 600 r, is applied, after paring. A similar treatment may be administered a month later if necessary. If this amount of radiation fails to cure, some other method of treatment should be instituted. In an excellent review of the treatment of plantar warts, Oliver (16) advises the administration of 3 erythema doses, repeated in eight weeks if necessary.

Chronic radiodermatitic ulcers resulting from over-treatment with x-rays of benign lesions such as warts are painful, disabling, and potentially dangerous because of the possibility of carcinoma formation. It is far better to fail to cure verruca plantaris with x-rays than to run the risk of obtaining a radiodermatitic ulcer in the attempt to eradicate such lesions.

CORNS AND CALLOSITIES

Both callosities and corns in my experience are unyielding to x-rays and radium. They are caused by improper foot gear, improper posture, or orthopedic disturbance. The treatment of these conditions depends upon the correction of such mechanical defects.

KERATOSES

Senile, seborrheic, and arsenical keratoses usually respond to radiation. The thick hyperkeratotic layer is first removed with a scalpel or curet and from one to four erythema doses (300 to 1200 r) of low-voltage unfiltered x-rays are applied to the closely shielded lesion. Thick proliferating keratoses, whether of the senile, seborrheic, or arsenical type, and those following overexposure to x-rays or radium, are probably best treated by scalpel excision or by electrosurgery. Since epitheliomas frequently follow keratoses, treatment by surgical means has the advantage of obtaining tissue for microscopic study.

KELOIDS

The etiology of keloids is obscure and their response to therapy is uncertain. They appear, in most instances, in a scar resulting from a burn, an operation, or other trauma. Keloids following burns are the most serious and most extensive. They occur on any part of the body of persons having a keloidal tendency. They range from very slightly thickened scar tissue (hypertrophic scar) to elevated tumors of different sizes. The color varies from reddish brown to a normal pinkish skin color. Telangiectatic vessels may be seen on the surface of some lesions. For the most part they are hard when palpated. Some are tender, but the majority are painless.

The small, rapidly growing soft keloids generally respond better to irradiation than the older growths which evolve slowly. Some respond to small doses of x-rays or radium and others are not affected even by maximum doses. For the soft, rapidly growing hypertrophic scars, treatment with unfiltered low-voltage x-rays is preferred. Seventy-five roentgens are given once a week to the closely shielded lesion for a total of six to eight treatments. In some cases it may be necessary to give as many as sixteen weekly treatments. The exact dose administered depends upon the location, duration, and size of the keloid and also upon the age of the patient. The larger the area covered by the keloid, the smaller should be the total dose.

When a keloid has existed for a year or more, it is best treated with filtered radiation. Four medium-voltage (140 kv.) treatments of 500 roentgens each filtered through 3 mm. of aluminum are given to the closely shielded lesion once every four to six weeks. Surgery combined with radiation in treating long-standing, resistant keloids is often superior to either method used alone. Under general or local anesthesia the keloid is excised and immediately afterward, while the wound is healing, x-rays are applied. At first unfiltered low-voltage radiation is used and if there is any tendency toward further keloid formation, radiations generated with 140 kv. and filtered through 3 mm. aluminum are employed. A dose of 275 r given every two weeks for a total of 4 to 6 treatments usually suffices. When keloids fail to respond to radiation alone or combined with surgery, they sometimes regress when treated with solid carbon dioxide in blistering doses.

There is not sufficient evidence to prove that the application of x-rays prior to an incision will prevent keloids. There are, indeed, many cases on record which tend to refute the contention that x-rays pre-

vent the development of a keloid in an idiosyncratic person. MacKee (6) cites the history of a young woman who developed a keloid after removal of a basal-cell epithelioma from the naso-labial fold by curettage and acid nitrate of mercury. The epithelioma had previously been treated with x-rays. Another case is that of a keloid which formed after a mole had been excised. The mole had been previously treated with x-rays. I have seen keloids develop following treatment of epithelioma with combined electrosurgery and x-rays. The conclusion to be drawn from these clinical experiences is that x-rays applied preoperatively do not prevent keloid formation. If, however, x-rays are used after the keloid begins to develop or before it has fully developed, it may respond favorably. To prevent the formation of keloids following surgical operation demands close observation of newly formed scars and irradiation as soon as there is any sign of hypertrophy. MacKee (6) writes (page 667): "It is doubtful if a single treatment with x-rays or radium subsequent to traumatism but prior to clinical thickening of the scar, would prove of value in preventing keloids. Furthermore, there is no certainty that a keloid will return after excision or that it will develop after traumatism in an idiosyncratic person."

HYPERTRICHOSIS

Excessive growth of hair on the arms, legs, and face of women is a cosmetic defect. During the past forty years many different methods have been devised for the removal of unwanted hair with x-rays; but none of them has been safe. Every successful permanent depilation with x-rays or radium has resulted in some degree of radiodermatitis. No matter what the voltage or filtration, how long the intervals between treatments, or what the rate of administration, if enough radiation is used to remove hair from any part of the body permanently, there will always follow visible damage to that portion of the skin lying between the surface and the site of the hair follicle. In some cases only slight telangiectasia and atrophy may result; in others the radiation sequelae may be so severe as to lead to the formation of keratoses and epithelioma. The use of x-rays for the correction of a cosmetic defect up to the point of causing permanent and dangerous cutaneous lesions is unjustifiable. Some justify a mild radiodermatitis following the x-ray treatment of hypertrichosis by stating that the patients are satisfied with the result. In my opinion there is no justification in removing a cosmetic defect and replacing it with a potentially dangerous condition. Besides, superfluous hair may be removed effectively and efficiently with the galvanic or the high-frequency current.

Time does not permit a consideration of many dermatoses amenable to radiation. Only a few of the more common diseases have been discussed. There are many other skin diseases, including cutaneous neoplasms, that respond to x-rays and radium which cannot be taken up in so short a paper. Enough diseases have been touched upon, however, to convey the dermatologic point of view as to the use of x-rays and radium.

CONCLUSIONS

1. High-voltage and heavily filtered x-rays for the treatment of diseases of the skin are unnecessary and undesirable.

2. When one takes into consideration the pathologic histology of many cutaneous disorders and studies absorption curves obtained with radiations generated with 40 to 100 kv., the conclusion is reached that if a skin disease responds to non-filtered x-rays generated with 100 kv., it should also respond to non-filtered x-rays generated with 40 kv.

3. Those administering x-rays for the treatment of cutaneous affections should know something about the natural evolution and involution of the diseases they are treating.

4. The general principles of treatment with hard rays of deep-seated conditions do not apply to superficial therapy.

5. The correlation of clinical and physical data tends toward better technic and more uniform dosage, and promises better therapeutic results and greater safety to the patient.

Note.—I wish to express my appreciation to Drs. MacKee, Wise and Mutscheller for reading this paper and offering valuable suggestions.

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DISCUSSION

J. R. DRIVER, M.D. (Cleveland, Ohio): In this interesting and timely paper Dr. Cipollaro sounds a note which I believe is appreciated equally by dermatologists and radiologists. I think we will all agree that the work of the dermatologists, chiefly Pusey, MacKee, Andrews, Cipollaro, and others, has been largely responsible for placing the irradiation treatment of certain skin lesions on a sound clinical and physical basis.

In my opinion, and as Dr. Cipollaro points out, there is to-day too great a tendency by many physicians to rely chiefly on the use of irradiation. Many skin diseases in which roentgen rays are commonly used will respond to the proper use of other procedures, and irradiation should be used only if these fail.

Again as pointed out in this paper, in such diseases as psoriasis and eczema, and in many cases of acne, the response is slow or temporary and as a result irradiation is sometimes continued to the point of irreparable sequelae. The radiologist is not the one who sees most of these unfortunate patients. They consult the dermatologist and it is for this reason that the dermatologists as a group are perhaps more conservative in the use of roentgen rays.

For many diseases in which the use of superficial therapy is indicated, small doses of low-voltage unfiltered x-rays are adequate. Frequently I use a dose of 50 r given every two weeks instead of 75 r every week. The response to this dose, when accompanied by other indicated procedures, is in many instances quite satisfactory. The less irradiation given consistent with satisfactory results, the better for the patient. This becomes apparent when we keep in mind the fact that future irradiation may be urgently indicated for the same or other conditions in the same areas.

I am in complete accord with the essayist as regards the use of low-voltage unfiltered or lightly filtered x-rays *versus* high- or medium-voltage heavily filtered rays for the treatment of superficial lesions. The chart shown seems to prove this point.

Acne vulgaris is, as Dr. Cipollaro has pointed out, perhaps the most commonly irradiated skin disease, but in my experience the response is many times disappointing in patients under seventeen years of age. The disease is not cleared up by the number of treatments that can be given safely, and later on, when x-rays

would be more effective, we are unable to give them because of the danger of sequelae. In these young patients, other methods are indicated and x-rays may be used later on if necessary.

I would like to stress this point because I see so many patients fifteen or sixteen years of age who have had all the irradiation that the skin can possibly stand, so that it will be impossible, even after a few years, to give them any more. For that reason I think that we should wait until seventeen or eighteen years of age before treating with x-rays.

I. S. TROSTLER, M.D. (Chicago): I think that this is one of the sorest spots on my irradiation anatomy! Every once in a while someone who owns an x-ray machine undertakes to treat some of the commoner skin diseases. He treats and he treats and then he treats some more. He treats by the minute and he treats by the hour. He treats with filters and he treats without filters. He treats with almost any voltage and at any anode-skin distance. Then all at once he gets into trouble. He receives notice that he is being sued for malpractice.

Not long ago I was asked by a dermatologist to help defend a malpractice suit. He had administered 48 successive treatments at weekly intervals. Some of these treatments were equivalent to 80 r; some of them, he said, were up to 100 and 120 r; but *none of them was measured* except by the voltage, the time, and the F.S.D. I had to tell him that I did not believe he could find any one who would justify such treatment, to which he replied: "Why, that is the way I treat them all the time!"

There is another situation that we find, particularly in the larger centers. A man buys an x-ray machine for fracture cases. A patient with a skin lesion comes along and the doctor proceeds to treat with x-rays because the man who sold him the machine told him how easy this would be. I know of at least a dozen such malpractice cases within the last five years. I do not need to assure you that it is easy to get into trouble in this way; it is not so easy to get out of it. In that respect it is much like a gill net or a mouse trap.

ANTHONY C. CIPOLLARO, M.D. (*closing*): I should like to reiterate that success in the administration of x-rays depends upon proper diagnosis and upon complete knowledge of the therapeutic agent.

THE ROENTGEN TREATMENT OF MYXOMATOUS CUTANEOUS CYSTS[1]

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THE fact that myxomatous cutaneous cysts are especially amenable to roentgen therapy has not received adequate emphasis in radiologic literature. Previously, these were included with "synovial lesions of the skin." In 1937, however, Gross (1) called attention to their true pathologic nature as a myxomatous degeneration of the corium, the strong tendency to recurrence despite wide surgical excision, and the curative effect of irradiation.

This subject may concern radiologists frequently enough that they should recognize the lesions and the necessity for the application of mild caustic irradiation. We have found the exposures recommended to be inadequate and suggest 1,400 to 1,600 r, measured in air, of low-voltage roentgen rays at one sitting as satisfactory treatment.

Seven cases are included to illustrate characteristic findings and favorable results following adequate radiotherapy.

ETIOLOGY

The cause of myxomatous cutaneous cysts is unknown. Several theories regard them as due to localized repeated trauma or to vascular changes resulting in local collagenous degeneration, as connective-tissue tumors with necrosis, a variant of Heberden's nodes of osteoarthritis, or development from an out-pocketing of a synovial membrane. There is no evidence to indicate an inflammatory origin.

INCIDENCE

These cysts are infrequent since, even in an active dermatologic service, only seven examples were found within three years. They occurred predominantly in women. The usual age group is that from the fourth to the sixth decade, although instances in patients as young as twenty-six years of age have been reported. All patients we studied were of the white race and, with one exception, were over fifty years of age. The occupation of the majority of the patients necessitated considerable use of the hands.

CLINICAL FINDINGS

The usual appearance is that of a globular, raised, smooth cyst which can be transilluminated and is covered by thin skin of normal color. It is commonly situated at one side of the dorsal aspect of a distal phalanx. When it is punctured, a thick, lemon-colored syrupy fluid can be expressed. If the cyst impinges on the root matrix, grooving of the nail results. The average diameter at the base is 5 mm. with an average height of 3 mm. The cysts are never reducible by forceful pressure in contradistinction to true synovial cysts or ganglia. Another differential point is that, since the myxomatous cyst is an integral part of the corium, the skin cannot be moved over it.

In unusual cases, the lesions may be extremely thin-walled so as to resemble vesicles; or they may be very rough, resembling verrucae (Fig. 1). Occasionally, the lesions are centrally umbilicated (Fig. 2). Atypically, they may also be encountered on parts of the fingers, toes, hands, or feet other than the distal phalanges. If recently traumatized or if secondarily infected, the base of the cyst may be surrounded by a small zone of inflammation.

The most common symptom is not pain but annoyance. Tenderness and pain develop if the cysts are greatly distended or infected.

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

PATHOLOGY

The histologic findings are demonstrated in Figure 3. The cyst lies beneath normal appearing epidermis and consists of a large rounded space lined by acellular, compact connective tissue that fades off into the corium. Small amounts of mucoid, basophilic material are contained within this space. The adjacent connective tissue exhibits areas of pre-cavitary myxomatous degeneration. No mucoid-secreting cells can be detected.

No abnormal leukocytic infiltration can be seen in or about the lesion. In the examined specimens, no evidence of trauma, such as extravasations of blood or deposits of hemosiderin, has been noted. The vessels leading to and in the immediate vicinity of the cyst are patent so that there is no question of thrombosis or occlusion.

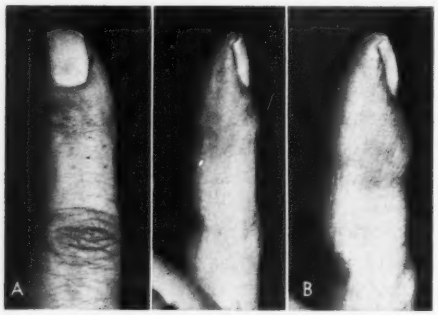


Fig. 1. Case 6: *A*. Verrucous type of myxomatous cyst on the terminal phalanx of the left index finger, of one month's duration. *B*. Disappearance of cyst three months following treatment.

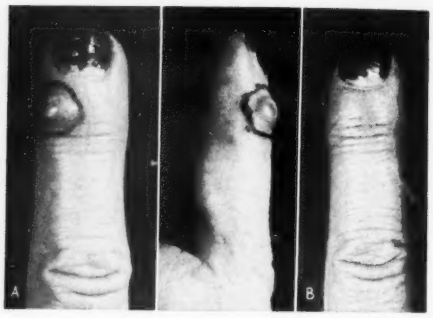


Fig. 2. Case 5: *A*. Umbilicated myxomatous cyst on the terminal phalanx of the left middle finger, of eight months' duration, showing area treated. *B*. Disappearance of cyst one month following treatment.

TREATMENT

Electrocoagulation, fulguration, chemical cauterization, incision and drainage, curettage, surgical excision, x-radiation, radium therapy, and even amputation have been used alone or in combination in the treatment of myxomatous cutaneous cysts. Permanent disappearance of the cyst resulted in every instance when an adequate amount of radiation therapy was used. Excluding amputation as an utterly needless procedure, recurrence was practically universal in two to three weeks following the other forms of treatment. In addition to being curative, irradiation gives a cosmetically perfect result, since no perceptible residuum of the lesion or scarring remains.

Low-voltage roentgen therapy was employed in the present series of cases in an attempt to determine the minimum amount and proper mode of treatment. As shown in the accompanying table, recurrences developed with the use of small amounts of x-ray and a protracted delivery. Consistently permanent results were obtained when a mildly caustic dose was given at one sitting. The physical factors were as follows: 100 kv. constant potential, 4 ma., 30 cm. focal skin distance, no added filtration, intensity 120 r per minute, portal size as determined by the lesion, 1,400 r to 1,600 r massive dose technic. Care should be taken to limit the portal to the base of the lesion, using adequate protection. This exposure was given to a small area with no undesirable effects and a permanent regression of the cyst occurred in from four to six weeks.

CASE REPORTS

Case 1. Dr. C. S. A., a 64-year-old physician, presented a vesicle-like lesion of the right middle finger of six months' duration. It appeared spontaneously and recurred repeatedly following incision and drainage and the use of caustics.

On examination a translucent, intradermal, globular, tense, tender cyst 5 mm. in diameter was present on the radial half of the dorsum of the distal phalanx of the right third finger. There was ridging of the nail at the level of the lesion.

Treatment and Course: Using a portal 1 cm. in diameter, 450 r were given in one exposure. The lesion remained unchanged one week later, when the amount was repeated. In three weeks, the lesion decreased 50 per cent in size; a third 450 r treatment was given at this time. Two weeks later, the lesion appeared softer and flatter but somewhat larger. An exposure of 1,500 r was then administered. The height of reaction, consisting of a brilliant erythema and a tense, tender cyst, appeared in three weeks. Two months later, the lesion rapidly disappeared in the course of one week. Ridging of the nail ceased with the resolution of the cyst. No recurrence has been noted in three years.

Case 2. Mrs. E. D., a 55-year-old housewife, complained of a tender swelling on her left index finger of one year's duration. A jelly-like substance exuded when it was pricked by a needle. Her physician removed the cyst by wide excision. Microscopic examination showed findings typical of myxomatous cutaneous cyst (Fig. 3) and the patient was referred for roentgen therapy. At the time of treatment, the site of excision was not completely healed, showing healthy granulation tissue.

Treatment and Course: An exposure of 800 r was delivered to the lesion, using a portal 1.5 × 2.5 cm. One month later the wound was completely healed, the area treated being marked by a brown pigmentation. There was no recurrence after two and one-half years.

Case 3. Mrs. G. A., 56-year-old housewife, complained of a painful "lump" that appeared on her left ring finger a year previously. There was recurrence despite two surgical attempts at incision with drainage and several instances of needle-prick drainage by the patient. On each occasion colorless mucoid material was obtained, with some relief of pain.

Examination showed a globular, tender, translucent cyst 4 mm. in diameter, covered with skin of normal thickness and surrounded by an inflammatory zone 1 cm. in diameter, just proximal to the base of the left fourth fingernail.

Treatment and Course: Using a portal 1.0 × 1.5 cm., 320 r were administered and repeated in three days. After one month, the lesion was definitely smaller, but a small amount of colorless, stringy material could still be obtained. Another course of two treatments of 320 r each was delivered. The patient refused further treatment.

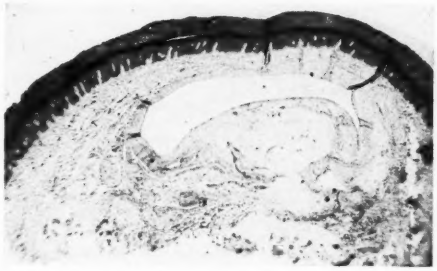


Fig. 3. Case 2: Photomicrograph of myxomatous cutaneous cyst showing characteristic acellular connective-tissue lining. Note pre-cavitary myxomatous degeneration in adjacent corium. × *c.*15.

Case 4. Mrs. M. L., a 52-year-old seamstress, complained of a "wart" on her right middle finger of four months' duration. She remembered that one year previously her finger at this site became quite irritated by her thimble while she was sewing on heavy rubberized material. Although not painful, the lesion was annoying and interfered with the patient's work.

On examination a slightly rough, nontender, globular cyst 5 mm. in diameter was noted 1 cm. proximal to the right third fingernail.

Treatment and Course: Using a portal 1 cm. in diameter, 480 r were delivered and repeated in two days. Five weeks later, slight bronzing was noted over the treated area and the lesion appeared smaller and softer. A second course of therapy, similar to the first, was given at this time.

TABLE I.—MYXOMATOUS CUTANEOUS CYSTS: SEVEN CASES

Case	Age and Sex	Digit Involved	Diameter of Lesion	Duration	Description	Treatment and Results
1. C. S. A.	64 M	Rt. 3rd finger, lateral aspect, terminal phalanx	5 mm.	6 mos.	Translucent, tense, tender, globular cyst. Ridging of nail	(1) Incision and drainage. Recurrence (2) Caustic applications. Recurrence (3) Protracted x-ray therapy 3 × 450 r. Recurrence (4) Caustic exposure—1,500 r. Lesion disappeared in 3 mos. No recurrence in 3 yrs.
2. E. D.	55 F	Left 2nd finger, lateral aspect, dorsum distal phalanx	5 mm.	1 yr.	Smooth, tender, translucent cyst	(1) Wide excision followed by (2) caustic exposure—800 r. Wound healed in 1 month. No recurrence in 2 1/2 yrs.
3. G. A.	56 F	Left 4th finger, dorsum base of fingernail	4 mm.	1 yr.	Translucent, tender cyst, surrounded by inflammatory zone	(1) Numerous puncture drainage. Recurrence (2) Two incisions and drainage. Recurrence (3) Two courses of two 320 r treatments. Lesion smaller. Patient refused further treatment
4. M. L.	52 F	Rt. 3rd finger, dorsum 1 cm. below nail	5 mm.	4 mos.	Slightly rough, globular, non-tender cyst	(1) Three courses of two 480 r treatments. (Tr. at 2-day intervals, courses at 6-week intervals). Resultant decrease of 50% (2) Caustic exposure—1,000 r—2 mos. following last course mentioned above. Lesion disappeared in 1 month. No recurrence in 2 yrs.
5. E. F.	58 F	Left 3rd finger, mesial aspect, dorsum terminal phalanx	5 mm.	8 mos.	Round, umbilicated, translucent, tender cyst	(1) Caustic exposure—1,600 r. Disappeared in 1 month. No recurrence in 1 year
6. J. M.	53 F	Left 2nd finger, mesial aspect, dorsum terminal phalanx	5 mm.	1 mo.	Rough, intracutaneous movable, translucent, tender cyst	(1) Single exposure—1,400 r. Disappeared in 10 wks. No recurrence in 1 year. (Had basal-cell carcinoma of skin of neck)
7. K. G.	40 F	Rt. 3rd finger, lateral aspect, dorsum distal phalanx	4 mm.	1 yr.	Rough, tender, slightly raised cyst. Ridging of nail	(1) Wide excision. Recurrence (2) Caustic exposure—1,600 r. Disappeared in 6 wks. No recurrence in 4 mos.

One month later the lesion appeared drier and harder, but since there was little change in size, a third series of two treatments was given. Erythema with desquamation was noted in two weeks, and in five weeks the superficial epidermis had peeled off leaving a thin-walled cyst 2 mm. in diameter containing a clear, thick, jelly-like material. One month later the horny epithelium reformed, with little change in the size of the cyst. An exposure of 1,000 r was now administered. In one month, the lesion "fell off" leaving a clean surface. Slight radiation reaction was still present. There was no recurrence after two years.

Case 5. Mrs. E. F., a 58-year-old housewife, complained of a swelling on her left middle finger of eight months' duration. This had increased in size and become pain-

ful in the past month. Hot poultices afforded no relief.

On the ulnar aspect of the left third finger, just proximal to the fingernail, was a round, tender, umbilicated cystic lesion 5 mm. in diameter (Fig. 2).

Treatment and Course: A caustic exposure of 1,600 r was given over a portal 1 cm. in diameter. One month later the lesion had disappeared and there remained a radiation erythema with desquamation over the treated area. No recurrence was noted after one year.

Case 6. Mrs. J. M., a 53-year-old housewife, complained of a painful "wart" on the left index finger of one month's duration. Almost two years previously, the patient had radiotherapy for an early basal-cell carcinoma that had developed in a verruca situated in the left supraclavicular region.

An intra-cutaneous, round, rough, movable, translucent, tender cyst 5 mm. in diameter was present on the ulnar side of the left second finger just proximal to the fingernail (Fig. 1). No evidence of the former malignant lesion was found.

Treatment and Course: A caustic application of 1,400 r was given to a portal 8 mm. in diameter. In three weeks a dusky erythema appeared in the treated area with increase of pain. Two months later the cyst gradually disappeared with accompanying relief of pain. There was no recurrence one year following treatment.

Case 7. Mrs. K. G., a 40-year-old waitress, complained of a swelling on her right middle finger that recurred six weeks after wide excision of a similar lesion of one year's duration. It was not painful but interfered with the patient's work.

A globular, slightly rough, non-tender cyst 4 mm. in diameter was present on the radial aspect of the right third finger, just proximal to the nail. There was definite ridging of the nail at the level of the cyst. The report of the microscopic examination was as follows: "Specimen exhibits typical myxomatous cyst as evidenced by area of rarefaction lined by acellular compact connective tissue. Areas of myxomatous degeneration noted in adjacent connective tissue within the corium."

Treatment and Course: A caustic exposure of 1,600 r was given, using a portal measuring 7 × 8 mm. Disappearance of the lesion followed in one month. No recurrence was noted after four months, and ridging of the nail was no longer present.

SUMMARY

1. Myxomatous cutaneous cysts should not be confused with synovial lesions of the skin, since the treatment of the former is preferentially radiologic.

2. They are the result of degenerative processes in the corium, the cause of which is not known.

3. The clinical findings are described and illustrated by seven case reports.

4. These lesions are prone to recur following surgical excision, whereas complete disappearance has been obtained with mildly caustic low-voltage roentgen therapy.

REFERENCE

(1) GROSS, ROBERT E.: Recurring Myxomatous, Cutaneous Cysts of the Fingers and Toes. Surg., Gynec. & Obst. **65:** 289–302, September, 1937.

ROENTGEN THERAPY OF HEMANGIOMATA[1]

By FRED M. HODGES, M.D., L. O. SNEAD, M.D., *and* R. A. BERGER, M.D.,
Richmond, Va.

SCATTERED comments are found in medical journals regarding roentgen therapy of the hemangiomata, occurring for the most part in discussions of articles in reference to radium therapy of hemangiomata or as casual insertions in papers summarizing periods of observation. For the most part these comments are quite favorable toward roentgen irradiation and the majority of them contend that good results are obtainable. In spite of this, the conclusions that are drawn continue to favor radium, either in the form of plaques or interstitially, the sclerosing agents, or electrosurgery, depending upon the particular method of the individual writer and his knowledge, faith, and success with it.

Our remarks will be limited to the strawberry hemangioma, the cavernous hemangioma, and a mixture of the two types. We are presenting this paper not as an argument against any form of therapy, but to offer some observations which show that equally good, or better, results may be obtained in certain types of hemangiomata by the use of roentgen rays. Filtered rays are used for certain selected cases and contact therapy for the more or less superficial strawberry birthmarks and for the mixed cavernous and strawberry types. Our experience convinces us that th's method of therapy has a definite value. Not only are the results good, but the technic is simple and easily applied by anyone experienced in this field.

CASE REPORTS

Case 1 (Figs. 1 and 2). M. W., a baby girl, the first-born child of parents of more than average intelligence, had a rapidly growing birthmark on the ear and face. When first seen by us she was six months of age and had been under active treatment by a competent dermatologist. He applied a full strength radium plaque to several areas on the face and the ear, but in spite of active irradiation therapy, to the point of ulceration, it was apparent that the lesion was still growing rather rapidly. For this reason the parents sought further advice. Because the child had had irradiation therapy and since some ulceration was present, we at first refused to consider the case, but through the insistence of the parents and with the consent of the dermatologist, we started treatments on Oct. 3, 1938. At this time, we would again point out, there was evidence of ulceration and infection of the ear and an irradiation reaction elsewhere throughout the lesion. With this in mind roentgen rays were employed, directed toward the entire lesion, which was inclosed by a cut-out lead shield to protect the adjacent parts. Two weeks later the child was again seen, vastly improved from the standpoint of infection and ulceration. As far as could be determined there had been no extension in the interval.

In view of the apparently favorable outlook it was considered advisable to continue the treatment. Consequently for the next thirty months, roentgen rays in small doses were used exclusively. During this period the bulkiness of the lesion subsided until the involved area was flush with the adjacent normal tissues; the ear flattened to its normal position, and most of the discoloration disappeared.

By the end of the twenty-sixth month it was felt that as much had been accomplished by filtered rays as might be expected. The cavernous elements were no longer palpable. Our attention was now directed toward the small superficial vessels which were scattered irregularly

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2-6, 1940.

Figs. 1 and 2. Case 1. Large hemangioma involving the angle of the jaw and ear. The result of filtered roentgen therapy is shown in the photograph on the right. The mass is gone, and the ear has returned to normal. Small superficial vessels still present are beginning to fade under contact therapy.

throughout the lesion. Supplementary treatments in the form of contact therapy were started and these we believe will destroy the elements still remaining.

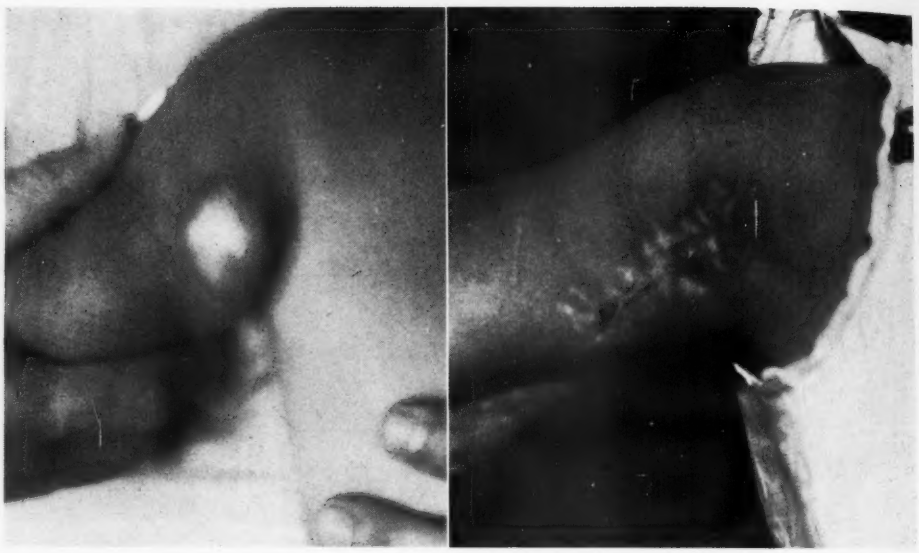
Comment: Two things in the management of this case may give rise to criticism: (1) the duration of treatment and (2) the possible latent effects of the earlier radium therapy. As to the first we feel that if treatments had been given more rapidly or more intensively we would certainly have had more scar tissue than is now present. The only visible scarring is that due to the infection and ulceration. It seemed to us that to obtain a pleasing cosmetic result with a minimal amount of scarring it was necessary to proceed cautiously.

The latent effects of radium must be considered. If radium had produced any beneficial effect other than superficial changes in this instance, we believe there should have been some retardation in the growth. This probably would have been obtained if heavier filtration had been used.

Although roentgen irradiation was directed to the salivary glands underlying the area, there has been no appreciable effect upon salivation. Other adequate forms of therapy would have done as much to the glands as roentgen therapy. Likewise there have been no secondary bone changes and the teeth have shown no deleterious effects, nor do we anticipate any.

We have not seen any damage to growth centers from the amount of radiation used in non-malignant growths, even in the very large hygromata, where much larger doses are necessary. Some of these cases have been followed for eighteen years or longer and show no irradiation sequelae. We believe that danger of secondary irradiation sequelae is remote. The reason for this is that the treatment was given over a long period of time and that only small doses were administered at each sitting. During the entire treatment interval the child received a total of 1440 r filtered through 3 mm. aluminum, at a focal skin distance of 25 cm. and at 135 kv. She never received more than 200 r delivered in air at one sitting. Most often the dose was 120 r, at a rate of 40 r per minute.

To keep the child quiet during treatments required, of course, the judicious use of restraining bands and demanded ingenuity on the part of the radiologist.



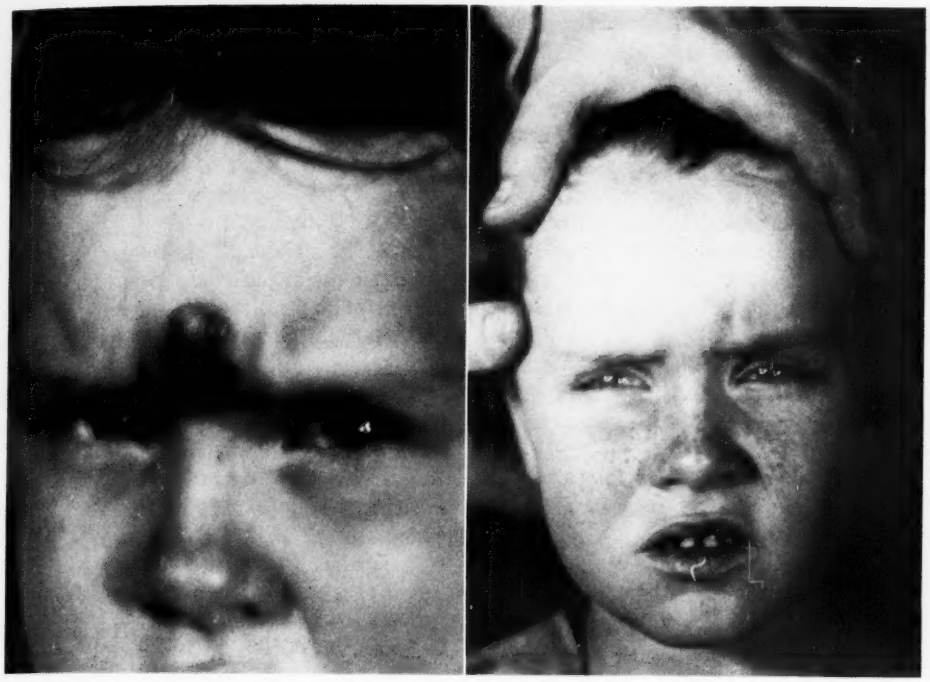
Figs. 3 and 4. Case 2. Mass remaining on the arm after the final stage of irradiation therapy. Fig. 4 (right) shows the arm after surgical excision of the mass.

We did not find it necessary to resort to the use of anesthetics.

We were not entirely successful in this instance in completely removing the discoloration by the use of filtered roentgen rays. It has been our experience in some other cases that filtered roentgen rays alone may not entirely eradicate discoloration and in these instances, as in the case recorded here, it has been necessary to employ supplementary therapy. As mentioned above, in this particular case we are using contact low-voltage therapy.

Occasionally we encounter cases in which the bulkiness of the mass cannot be entirely reduced. This would obtain in radium therapy as well. Such cases require surgery in the final stages. The following case is an example.

Case 2 (Figs. 3 and 4). T. S., a baby girl of six months, was referred to us with a cavernous hemangioma on the cheek and upper part of the left arm. These areas had been treated previously by a dermatologist, who used a radium plaque (full-strength applicator as far as we could determine). Under radium therapy there was a continuation of the growth. Since we did not know the amount of radium that had been used, we thought it advisable to proceed cautiously with roentgen rays, employing much the same method and dosage as in the preceding case. Under this form of treatment the lesion on the face regressed nicely and a nearly perfect result was obtained. The lesion on the arm became much smaller and the discoloration entirely disappeared. A residual tumor, however, remained stationary for several months. From all external signs this appeared devoid of any marked vascular elements but on palpation felt like a flabby fatty mass. It was thought that this would best be excised surgically, since it was apparently well encapsulated. It was accordingly removed and was described as follows: "The removed specimen consisted of a tumor including skin measuring $5 \times 2.5 \times 2.5$ cm. . . It was fairly well encapsulated, definitely benign and showed a combination of well irradiated hemangioma and a large amount of lipomatous tissue. There were still some vessels left but practically all of the hemangiomatous elements had disappeared."



Figs. 5 and 6. Hemangioma of the forehead, extending into the eyebrow, with a large soft mass beneath the discolored area. Fig. 6 (right) shows the result of treatment. There is no evidence of a mass and the skin has not been affected.

Comment: In this case a point was reached after which there was no further regression in the size of one mass while the similar lesion on the cheek had subsided. Any safe amount of therapy would not have destroyed the fatty elements which were present in this mass.

Each of the preceding cases required treatment supplementing the filtered roentgen beam. This is not the rule in the majority of cases treated by this method.

Case 3 (Figs. 5 and 6). In March, 1937, A. A., three years of age, was referred to us with a lesion 3.5 cm. in diameter, on the forehead. This was present at birth and had continued to grow slowly. Because of the long distance that the child had to be brought for treatment, it was thought advisable to deviate from the normal method and give a larger dose at a sitting. Also because such lesions as a rule become rather resistant to irradiation after the first year of life, we believed that heavier doses were indicated.

The appeal cannot be made too strongly at this point for the early treatment of hemangiomata. Most strawberry, cavernous, and mixed strawberry and cavernous hemangiomata are first noticed as small lesions during the first few weeks of life. It is a well known fact that in their early and growing stages, these lesions are radiosensitive and that they lose their radiosensitivity as the cells become more mature. The lesion in this child, however, although of several years' duration, responded much more favorably to treatment than one would ordinarily anticipate. Lesions of this age appear to tolerate larger doses with less reaction but we do not feel that this is an argument for delayed therapy.

Though the hemangioma encroached upon the eyebrow, the therapy used did not, as far as we could observe, destroy any

of the hair follicles. If the hair follicles have not already been destroyed by the growing lesion it has been our experience that they can be preserved for the most part under roentgen therapy, providing the doses remain well below the epilation level.

It is relatively easy to direct the roentgen beam over a specified area by means of lead cut-out masks. This assures a more uniform distribution of the radiation to the area treated than can be obtained with radium plaques unless one has an unlimited amount of the latter element. The danger of overlapping and missed spots is also eliminated.

Contact therapy has offered to the radiologist an ideal method for certain forms of birthmarks. We believe strongly that in the future this will be the procedure of choice in selected cases of hemangioma and lymphangioma. Our experience has shown it to be rapid, safe, and, above all, efficacious. The dose is readily ascertained and controlled, the application is extremely simple, and the demarcation between normal and abnormal tissue is so quickly obtained by the variety of cones which can be used, that this method of therapy is as easy as placing a radium plaque in position.

Examination of the nineteen consecutive records of infants treated for small strawberry birthmarks in the past ten months has given us some interesting information. Nine of the patients have been discharged or will be discharged from further active therapy on their next visit. All of these, in our opinion, show excellent results, and by this we mean that it is practically impossible to ascertain the location of the lesion if this was not previously known. The shortest period of observation of any one case was two months, while the longest was ten months. Of the remaining patients, not yet discharged, none has been observed over six months. This short series of cases has indicated to us that contact roentgen therapy brings about a more rapid disappearance of these lesions, in our hands at least, than radium, and we now employ the method almost exclusively in preference to radium element either in contact or at various distances for certain forms of hemangioma.

With contact roentgen therapy one treatment is given, on the average, in four or six weeks. Our dose is of only three seconds' duration, in which time we deliver 400 r in air. This amount produces little or no reaction in the tenderest of skins in the youngest infant, whereas four seconds or 532 r has produced some reaction, which we feel is not necessary.

CONCLUSIONS

1. We believe that contact roentgen therapy is the method of choice in the treatment of superficial strawberry hemangiomata.

2. In our experience the mixed strawberry and cavernous types respond best to filtered rays or to a combination of filtered and unfiltered rays.

3. We have been able with this technic to give a more uniform dose to the entire lesion and a smaller percentage of cases have required supplemental surgery.

DISCUSSION OF PAPERS ON HEMANGIOMATA AND MYXOMATOUS CYSTS

U. V. PORTMANN, M.D. (Cleveland, Ohio): Attention has been called to a very useful and a much neglected method for treating hemangiomata. I believe that radium has been preferred in the past because it has been easier to apply to squirming infants. Since the development of protected shock-proof roentgen-ray apparatus delivering large quantities of radiation, however, treatment can be given quickly, safely, and effectively to these young patients.

Sometimes it is difficult to irradiate large hemangiomata homogeneously and evenly with radium. Some areas may not be treated adequately, leaving blotchiness that is difficult to eradicate. Since the biological effects of radium and roentgen rays are similar, there is no reason for not using roentgen therapy for many of these lesions.

I have been impressed with the advantages of contact roentgen therapy, especially for the more superficial types of hemangioma. As the authors state, treatment can be given to an area in a few seconds so that there is little difficulty in applying it. We began cautiously, giving about 200 r to each area, using distance and filter according to the thickness of the hemangioma. Perhaps larger doses would be preferable.

The paper of Drs. Jacox and Freedman is a very comprehensive one compared to other publications on what they choose to call "myxomatous cutaneous cysts." In the literature these lesions usually have been called "synovial cysts," perhaps incorrectly. They are uncommon. We have seen less than a dozen. Radiologists seldom see them because dermatologists usually make the diagnosis and treat them. As the authors state, the dosages recommended have been small. I think it is perfectly logical to give larger ones as they suggest. I wonder, however, if Drs. Jacox and Freedman actually give as large tissue dosages as they think to the small areas used, in comparison with the calibrations of quantity of their apparatus made for larger fields.

W. HERBERT MCGUFFIN, M.D. (Calgary, Alberta): I should like to ask Dr. Freedman if he has met with any cases of telangiectasia following the use of contact therapy in surface vascular lesions. About four years ago I commenced using Chaoul contact therapy for the small hemangiomata. Recently several of the patients thus treated have exhibited tiny dilated veins, and it is my contention that the dose intensity was too great. I am now inclined to return to my previous method, applying half-strength radium plaques.

GEORGE W. GRIER, M.D. (Pittsburgh, Pa.): I should like to ask how Dr. Berger decides whether he will use unfiltered or filtered radiation. I should also like to ask if he approves of the use of radium plaques in the treatment of hemangiomata. I have felt that the radium plaque is unsuitable for these lesions. I believe filtered radium should be used instead.

R. A. BERGER, M.D. (*closing*): In answer to the question concerning telangiectasia, we can only state that our experience with contact therapy has not covered a sufficient period for such changes to be observed. The suggestion of Dr. Portmann, however, is a good one. By reducing the dose of irradiation closer to 200 r instead of approximately 400 r, which gives us some reactions, we may be able to eliminate subsequent telangiectasia.

Regarding the question of Dr. Grier concerning the use of filtered and unfiltered irradiation, we employ filtered rays only in selected cases of cavernous hemangiomata. The superficial type of lesion responds well to the unfiltered beam. The depth dosage desired determines what quality ray should be used.

We have not entirely eliminated the use of radium in the treatment of birthmarks. We feel, with Dr. Portmann, that some of the larger lesions can better be treated with x-rays, since the irradiation beam can be more evenly distributed, thereby reducing the possibility of missed spots or the danger of overlapping.

There are three things which deserve emphasis. First, good results may be obtained by roentgen irradiation in small doses. Secondly, an adequate interval between applications is desirable. Finally, a long period of observation is necessary.

ROENTGEN CHANGES IN THE CRANIAL VAULT ACCOMPANYING DISEASES RESULTING FROM METABOLIC DISTURBANCES[1]

By HUGH F. HARE, M.D., *Boston, Mass.*

From the Department of Radiology, The Lahey Clinic

DISEASES associated with metabolic disturbances frequently produce changes in the osseous system which, with improved roentgen technic and increasing experience, are more frequently recognized and successfully diagnosed than previously. Naturally, the degree of bony change and the ease with which it is demonstrated roentgenologically depend upon the stage of the disease and whether it is localized or generalized. It is becoming increasingly apparent to roentgenologists that there are more diseases which affect the osseous system than was previously realized and that a definite diagnosis from the roentgenogram alone is not warranted.

The various metabolic disturbances which may lead to changes in the cranial vault are given in Table I, with some of the laboratory findings.

Hyperparathyroidism.—The symptoms and signs of hyperparathyroidism are now generally recognized. It is a progressive disease associated with weakness, backache, progressive round back, and ease of fatigue. Loss of height is common, due to bone softening. The physical findings are frequently negative except for the dorsal round back, the increased lumbar lordosis, and loss of height. A palpable tumor in the region of the parathyroids may or may not be present. The laboratory findings are significant in that there is an increased serum calcium, a lowered serum phosphorus, and an elevated serum phosphatase value. Metabolic studies reveal a negative calcium balance.

Roentgen changes apparent in the vault are: (1) cystic changes and (2) osteoporosis in which there is a granular decalcification accompanied by thickening of the diploetic portion with or without cystic alterations and with a loss of the usual table markings (Figs. 1 and 2). In most instances the jaw bones are also involved.

A study of two cases which were followed roentgenologically after removal of the parathyroid adenoma revealed that the cranial vault undergoes changes along with a return of the patient to normal. In both instances the bone became quite dense and the table markings were lost. The appearance was similar to the productive phase of osteitis deformans. It is interesting that in neither case did the bones of the remaining osseous system return to normal, although there was some improvement as denoted by an increase in the calcium content of the bone.

TABLE I.—BONE CHANGES IN METABOLIC DISTURBANCES

(Osteoporosis common to all)

	Cystic Change	Serum Calcium	Serum Phosphorus	Serum Phosphatase	Calcium Balance
Hyperparathyroidism	+	+	L	+	−
Hyperthyroidism		N	N	N	−
Non-tropical sprue	+	+	N	N	−
Hypogonadism		N	N	N	−
Menopausal osteoporosis		N	N	N	−
Cushing syndrome		N		N	−
Calcinosis universalis		N		N	−
Osteomalacia		N		+	
Multiple myeloma		N +			N −
Osteitis deformans (biphasic)		N +	N +	N +	N −
Metastatic malignancy		N +			− N

+ = Present or above normal. L = Low. − = Negative calcium balance. N = Normal.

Hyperthyroidism.—This disease brings about changes in bone due to high meta-

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

Fig. 1. Hyperparathyroidism. Preoperative roentgenogram of skull.

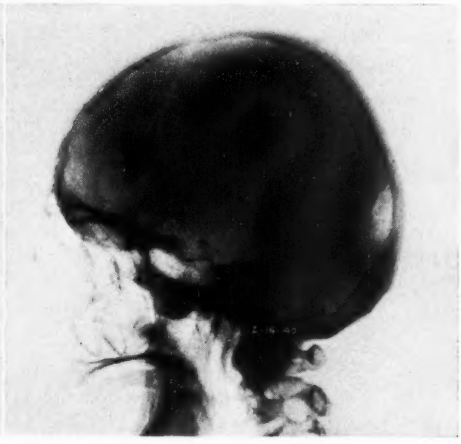


Fig. 2. Hyperparathyroidism. Roentgenogram taken five years postoperatively.

bolic activity. It has been demonstrated by Aub and others that the calcium excretion in this condition is 231 per cent greater than normal. It is also noted that in most instances of hyperthyroidism, because of an increased appetite, the diet has a high caloric content and the calcium intake is therefore greater than normal so that osteoporosis is a late phase of the disease. In two instances the bones have become so soft that pathologic fractures have occurred. In hyperthyroidism the serum calcium, phosphorus, and phosphatase values are within normal limits, while there is a negative calcium balance. The cranial vault shows osteoporotic changes similar to those seen with menopausal osteoporosis, hypogonadism, and the osteolytic phase of Paget's disease.

Non-tropical sprue or idiopathic steatorrhea has been diagnosed five times in our clinic during the past year. In three instances backache was the presenting symptom, although weakness, diarrhea, and progressive loss of weight were common features. Diagnosis in each instance depended on the finding of excess fatty acid crystals in the stool, but the following features also were usually present: (1) mild anemia, (2) a flat glucose tolerance curve, (3) flat vitamin A absorption curve, (4) vitamin D deficiency.

The roentgen findings are similar to and indistinguishable from those of hyperparathyroidism (Fig. 3). In all instances the cranial vault has been involved, with the same granular osteoporosis present as in diseases in which there is a rapid loss of calcium. The loss of calcium in this instance is probably due to lack of absorption, as serum calcium, phosphorus, and phosphatase levels are within normal limits. There is a negative calcium balance.

Hypogonadism.—Hypogonadism, as the name implies, is a disease associated with lack of gonadal secretion wherein secondary sex characteristics fail to develop or may develop normally but later, before epiphyseal closure; a lack of gonad activity is apparent, as evidenced by continuation of bone growth. In this condition, epiphyseal fusion is delayed until the later years of life so that the span of the individual is greater than the height, thus producing a form of gigantism.

A typical case of hypogonadism diagnosed in a patient fifty-five years of age is presented to show the osteoporosis which accompanies this disease (Fig. 4) and the laboratory findings which are present in this condition. The serum calcium, serum phosphorus, and the serum phosphatase values are within normal limits, while the calcium balance is negative. One

Fig. 3. Non-tropical sprue, showing granular decalcification.

would expect this condition to respond to treatment with estrogenic substances, as does menopausal osteoporosis.

As previously reported (Hurxthal and Hare), the findings of hypogonadism are subcalcification, long tapering bones, and lack of fusion of the epiphyses.

Menopausal osteoporosis is a common condition which has frequently been mistaken for hyperparathyroidism. It is associated with pain in the back, dorsal round back, increased lumbar lordosis, and weakness. The laboratory findings are as follows: serum calcium normal; serum phosphorus normal; serum phosphatase normal; calcium balance negative. The roentgen findings are osteoporosis of a non-specific type, frequently producing changes in the cranial vault and compression fractures of the spine.

It has been noted that these patients improve symptomatically following treatment with estrogenic substances, but thus far improvement has not been observed roentgenologically following treatment.

Cushing's Syndrome.—This disease is infrequently diagnosed but through the courtesy of Dr. M. C. Sosman we are able to present one case, seven years following treatment. This patient is a young woman, first studied in 1933. At that time careful studies were made and the serum calcium, serum phosphorus, and serum phosphatase values were found to be normal. There was a negative calcium balance. Dr. Sosman treated this patient and the results are apparent in that the patient is well. The bones have returned to normal, with a reverse in the calcium balance to normal.

Adrenal Tumors.—Adrenal tumors may produce the same syndrome as Cushing's disease. We have not had the opportunity to study such cases.

Calcinosis universalis.—In this disease calcium occurs in the subcutaneous tissues, and there is bone softening, as one would expect with the excessive calcium output, namely, a generalized osteoporosis. Studies have revealed normal serum calcium, phosphorus, and phosphatase values, with a negative calcium balance.

Osteomalacia.—Osteomalacia is a disease which may be reported more infrequently now than previously, since certain of these instances are probably advanced cases of menopausal osteoporosis.

Multiple Myeloma.—This disease produces bone changes in the osseous system and in the cranial vault similar to those found in other diseases with calcium imbalance. The serum calcium, phosphorus, and phosphatase values are within normal limits and the calcium balance may be normal or negative.

Metastatic Malignancy of Bone.—Metastatic tumors of bone may produce changes similar to those of other metabolic disturbances, as a result of replacement of calcium by malignant tissue. Yet the serum calcium and serum phosphorus levels are usually within normal limits, although the serum calcium has in some instances been elevated and there has been a negative calcium balance.

Roentgenologic changes in the cranial vault in this condition may so simulate those of other diseases that differentiation is impossible. Metastatic malignancy involving the cranial vault is not characteristic in cases in which there is a generalized osteoporosis. In some instances a definite diagnosis cannot be made by study of the cranial vault alone.

Osteitis deformans.—This, presumably a

metabolic disturbance, is the only disease in which a definite diagnosis may be made by the roentgenogram alone. Osteitis deformans may occur in several phases, and early diagnosis may in many instances be made by an understanding of the bone changes previous to the usual characteristic picture. There are (1) an absorptive phase, osteoporosis circumscripta, (2) a productive phase, and (3) a biphasic form of the disease. Laboratory findings which are common to all phases are normal serum calcium and phosphorus values and a normal calcium balance, while the serum phosphatase level is elevated.

Osteoporosis circumscripta is, as the name implies, a localized osteoporosis, usually affecting the cranial vault, with an absorptive area sharply demarcated from normal bone. The process involves all tables, giving the appearance in the roentgenogram of bone without trabeculation.

The productive phase is one wherein an increased amount of calcium is laid down in the cranial vault, with widening of the diploetic portion and obliteration of the table markings, that is, fusion of the diploetic portion with the middle and outer tables to such an extent that no diploe are seen. This is the type which is present with leontiasis ossium, and in this instance the frontal bone is also involved.

A recent review of 67 cases of Paget's disease revealed 7 instances of monophasic Paget's disease. In each instance the roentgen diagnosis was confirmed by an elevated level of serum phosphatase.

The biphasic form of Paget's disease is a mixture of the productive and absorptive phases, producing a peculiar architecture of the bone, with areas of rarefaction and of increased density. The roentgen findings are explained by the pathology of this condition, namely, a process of decalcification accompanied by hyperplasia of the connective tissue in the circulatory mechanism of both the bone marrow and the haversian system, and later an irregular ossification of this connective tissue. The poor quality of the new bone is probably due to the fact that it is laid down on the foundation structure of connective tissue rather than on well organized cartilage, which forms normal bone. The marrow cavity is encroached upon and the cortex is exaggerated.

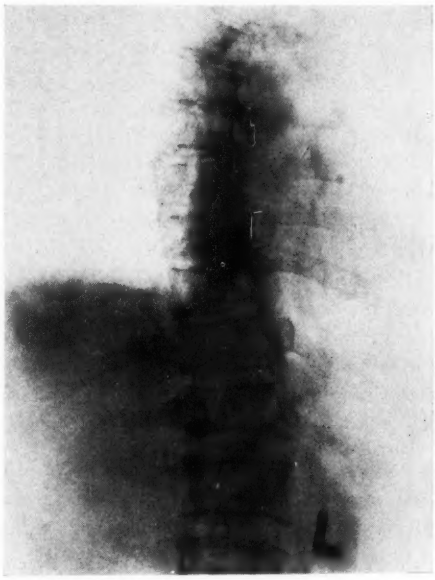


Fig. 4. Hypogonadism.

Roentgenograms of the skull were made in 45 of the 67 patients studied. Of these, 38 were positive for Paget's disease, 2 were doubtful, and 5 were negative. These last 7 patients, of course, had Paget's disease elsewhere in the body. This shows the frequency with which the cranial vault is affected. Of the 5 patients whose roentgenograms were negative, none had symptoms referable to the head. Of those regarded as doubtful, one had fainting attacks, which were probably unrelated to the Paget's disease. Of the 38 positive patients, 10 complained of headache alone. Fifteen others had one or more of the following symptoms: enlargement of the head, spasm of the facial muscles, dizziness, headache, and hemiparesis. In addition, 2 patients also had syncopal attacks, and one epilepsy, which may have been unrelated to the Paget's disease. Thirteen had no symptoms referable to

the head, in spite of roentgenographic evidence of osteitis deformans.

DISCUSSION

JOHN D. CAMP, M.D. (Rochester, Minnesota): The very interesting group of cases which Dr. Hare has presented illustrates the great variety of conditions which may produce essentially the same roentgenographic change in the skeletal system. The whole problem is perhaps a little better understood if we bear in mind that the skeletal system is not entirely fixed in its composition but is actually a living structure that is constantly undergoing metabolic changes because of the circulation of the blood and lymph. As a result any changes in the circulation, the chemical or physical content of the blood, and the various hormonal substances which are transported by it, are going to be reflected in the skeletal structure itself.

Because of the complexities of the physiochemistry of the skeletal and endocrine systems, the early diagnosis of many of these conditions by the roentgenologist is almost impossible.

Dr. Hare has commented on idiopathic steatorrhea or non-tropical sprue. I think the changes in the mucosal pattern of the gastro-intestinal tract often help in arriving at a diagnosis in this condition when the skeletal changes are not so obvious. In these days of vitamin propaganda, it is difficult to understand why we are seeing more and more cases of so-called avitaminosis or deficiency disturbances. Whether vitamin ingestion indiscriminately has anything to do with it or not, I do not know. Nevertheless, bone metabolism is very complicated and I believe that we should think a great deal before we attempt to tamper with such intricate biochemical processes by means of a few pills or capsules.

Dr. Hare spoke, also, of the effect of iodine and the thyroid. I might mention the case of a youngster with a chromophobe adenoma of the pituitary. Pituitary tumors of the chromophobe type, so far as I know, do not cause alterations in the mineral content of the skeletal system, but this youth had a very profound osteoporosis and a compression fracture of one of the thoracic vertebrae which we believed secondary to the osteoporosis. The history revealed that the patient had been taking thyroid extract over a period of a year in order to reduce his weight, and as a result had lost 50 pounds. It was evident that he had hyperthyroidism, which we felt accounted for the change in bone density.

Stafne has found in dental roentgenograms of patients with Paget's disease a hypercementosis about the roots of the teeth and obvious changes in the radiographic density of the mandible which, in our experience, may often antedate any other skeletal change.

Some conditions which may imitate many of the changes Dr. Hare has presented are those incident to the blood dyscrasias in childhood, the leukemias and erythroblastic anemias, which I am sure he would have considered if there had been time.

I should like to compliment Dr. Hare on this interesting group of cases and emphasize again that radiologists are in a good position to assist the clinician in the recognition of many of these conditions. We cannot always make a concrete diagnosis, as Dr. Hare has emphasized, but we can do a great deal by the methods at our disposal to steer the clinician to the right method of treatment.

EUGENE FREEDMAN, M.D. (Cleveland, Ohio): Dr. Hare's paper showing the various metabolic conditions which may produce structural changes in the cranial vault is a most interesting one. As both Dr. Hare and Dr. Camp have pointed out, the changes are very seldom typical enough to permit an unequivocal roentgenologic diagnosis of the underlying condition.

I agree, however, with Dr. Camp that it rests with the roentgenologist to point out to the attending physician the possible relationship between the changes in the cranial vault and the known clinical condi-

tion, and the possible line of investigation that should be carried out in order to establish a diagnosis.

I should like to call attention to an anatomical variation in the bone structure, the roentgen ray appearance of which is very similar to changes produced by metabolic disturbance. In this condition the intertrabecular spaces are much wider than normal, and upon casual inspection the bones appear to be osteoporotic. Closer study, however, reveals that the trabeculae are neither thinned nor decalcified. The appearance of osteoporosis is produced merely by the wide intertrabecular spaces.

Dr. John Camp tells me that he has encountered several such cases, where a thorough clinical investigation failed to reveal any associated pathologic condition, and he considers the condition to be an anatomical variation in bone formation.

MERRILL C. SOSMAN, M.D. (Boston, Mass.): Dr. Camp mentioned the possibility of increased density around the teeth as a helpful diagnostic feature in Paget's disease. In this connection I should like to call attention to a second point, which is also helpful, the fact that in the osteoporosis of hyperparathyroidism the lamina dura of the tooth socket is usually gone. It is well known that there is a dense wall around the socket of the tooth. If hyperparathyroidism is suspected it is easy to take a dental film and if the lamina dura is gone, the diagnosis is almost always certain. We have a wide-awake dentist in our Clinic who has made the diagnosis of hyperparathyroidism from a dental film.

HUGH F. HARE, M.D. (*closing*): This is a very interesting group of cases with which to work. I am sure that I failed to emphasize sufficiently one idea, that is, that serum calcium and serum phosphorus may be normal and there still may be a negative calcium balance. The calcium balance studies are the all-important ones.

EPIDUROGRAPHY

A METHOD OF ROENTGENOLOGIC VISUALIZATION OF PROTRUDED INTERVERTEBRAL DISKS

By HAWLEY SANFORD, M.D., *and* HOWARD P. DOUB, M.D., *Detroit, Michigan*

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THIS report concerns a method proposed for the roentgenologic visualization of protruded intervertebral disks. All of the usual procedures employed for this purpose have disadvantages. The positive contrast media, of which lipiodol is the one most commonly used, may prove locally irritating and necessitate the opening of the dura at the time of operation. Thorium dioxide is a potentially radioactive substance and its use has not been generally accepted. The popular air myelogram or spinogram, which is a film taken of air in the subarachnoid space, does not compare with other methods in diagnostic accuracy. It has the added disadvantage that unless the patient remains supine for at least twenty-four hours the air will enter the cranial cavity, causing intense headache. The use of oxygen instead of air, as recommended by Poppen (10), will evidently shorten the interval that the patient has to stay in bed.

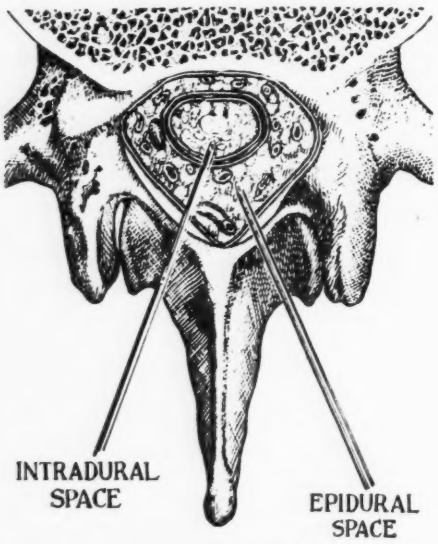

Fig. 1. Transverse section of the spinal canal at the level of the second lumbar vertebra (from Odom). The needles are portrayed as being placed obliquely. It is our practice to insert them in the mid-line.

In our attempt to find a more suitable method of demonstrating protruded intervertebral disks, and more particularly to avoid the headache and discomfort caused by air myelography, it was decided to introduce the air into the epidural rather than the subarachnoid space. It was recognized that Odom (8, 9) and others (1, 2, 4, 5, 7) had utilized this space for the giving of anesthetics, but no reference was found in the literature regarding the injection into it of a contrast medium for clinical roentgenographic purposes.

The spinal epidural space is that area within the spinal canal which surrounds the dura, extending the entire length of the spinal canal, from the rim of the foramen magnum to the coccyx. Its upper limits are tightly sealed at the foramen magnum so that air or other substances injected into the space cannot enter the cranial cavity. Nor is there any communication between this space and the subdural or subarachnoid spaces. It is larger than is commonly realized; in the lumbar area its total diameter exceeds that of the subarachnoid space (Fig. 1).

Heldt and Moloney (6), as well as Soresi (11), noted a negative pressure within the epidural space. Whether this is a true negative pressure or merely a spurious one caused by indentation of the dura by the point of the needle has been debated, recently by Eaton (3). Without detailing at this time the reasons for our con-

viction, it is our opinion that in certain patients under certain conditions, principally those having to do with position, a true negative pressure exists. Whether this be true or spurious, it can be utilized in locating the space, by attaching to the needle a manometer which registers negative pressures, or, more simply, by placing a drop of fluid in the

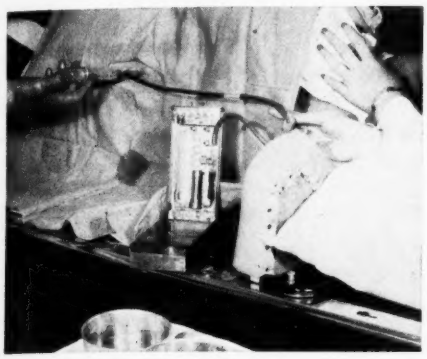

Fig. 2. The needle with the manometer attached is in the subarachnoid space. The needle with the syringe attached is being inserted into the epidural space.

open end of the needle, which is inserted slowly until the drop is aspirated. This technic may be employed in doing epidural punctures, but at times, in spite of the greatest caution, the subarachnoid space will inadvertently be entered before an indication of negative pressure is obtained. The epidural injection can be done through the sacral hiatus, but to us such a procedure is more difficult than the one to be described.

After trying several of the various methods for locating the epidural space we have found the following to be the most reliable.

The punctures are performed on a tilting table equipped with a Bucky diaphragm. A needle is inserted at the third lumbar interspace so that the subarachnoid space is entered. A manometer is attached to this needle. With a second lumbar puncture needle the skin is pierced at the fourth lumbar interspace and the needle inserted until it is felt to engage in the interspinous ligament. It is then withdrawn and a short-beveled, rather blunt Pitkin needle is inserted into the canal made by the sharper needle. This blunt needle will tend to push the dura and blood vessels ahead of it rather than to pierce them. As soon as it is felt to be in the interspinous ligament the stilet is removed and an air-filled syringe attached. The needle is

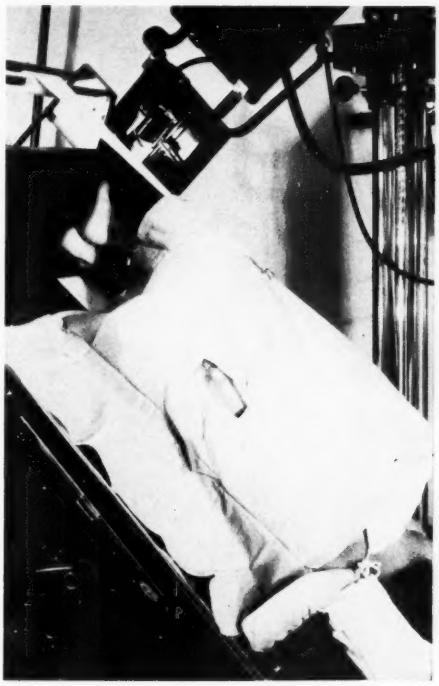

Fig. 3. Position of the patient during the injection of the air and exposure of the films.

then pushed in very slowly and at frequent intervals pressure is made on the plunger of the syringe. As long as the point of the needle remains in the ligament, no air can be injected unless force is used. Just as soon as the point enters the epidural space the air can be injected with ease; in so doing the dural sac is compressed, which causes an elevation of the fluid in the manometer attached to the other needle (Fig. 2).

As soon as both needles have been properly placed the manometer is disconnected from the needle in the subarachnoid space

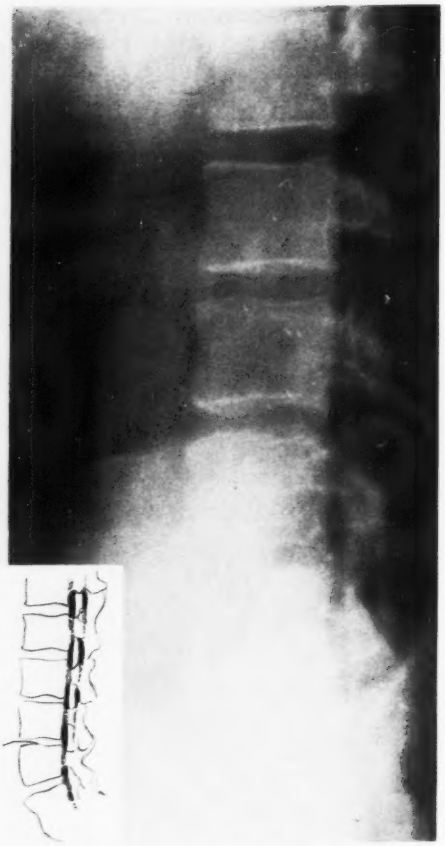

Fig. 4. Normal epidurogram.

and a sample of cerebrospinal fluid is obtained. The routine complete examination is made of this fluid, with particular attention to the amount of total protein. The collection of fluid is done at this time, for after the injection of air is started the dural sac seems to collapse around the roots of the cauda equina, and little or no more fluid can be obtained. After the fluid has been collected, the lower end of the spinal canal is elevated by tilting the table to an angle of forty-five degrees.

Figure 3 shows the sponge rubber shoulder rest and the windlass for the support of the knees which are used in this procedure. With these supports, angles of tilt are possible which otherwise could not be obtained, and they add materially to the patient's sense of security and comfort.

After the table has been tilted, air is injected into the epidural space. This is done rapidly, and a surprisingly large amount can be introduced without apparent harm. As much as 600 c.c. has been injected without any increased resistance to the plunger of the syringe. Such large amounts actually are not necessary and we now use between 200 and 300 c.c., depending upon the size of the patient. Stereoscopic films are made in the lateral view, as well as small films localized over the lumbosacral area. Proper calculations are made for the size of each patient and the exposure used is a little longer than would ordinarily be recommended for bone detail. This moderate overexposure brings the air column into sharper contrast.

For some reason air in the epidural space shows poorly in the anteroposterior view and we have discontinued the use of this position. Despite this apparent disadvantage, the epidurogram[1] appears to be diagnostically more accurate than does the air myelogram.

One particular advantage of this method is that, inasmuch as the air does not enter the cranial cavity, the patient can walk from the table and can be seen for further diagnostic studies the same day.

At first the above procedure may seem unduly complicated, but in practice it is quite simple and the examiner soon learns to know when the needle is in the epidural space by the sensation transmitted through the shaft as the point enters the different layers. There may be some objection to the use of two needles, and the injection could, of course, be done with one. A specimen of fluid should be collected, however, and if a single needle is inserted into the subarachnoid space, the fluid is collected, and the needle is then withdrawn into the epidural space, the subsequent injection of air aimed directly at the resulting opening in the dura will frequently force air into the subarachnoid space.

[1] The term "epidurogram" is proposed for the roentgenogram of the air-filled epidural space. "Epidurography" is suggested as a name for the procedure.

In Figure 4, which shows a normal epidurogram, it can be seen that a well defined column of air sharply outlines the posterior edges of the bodies of the vertebrae and the interspaces, and that none of the disks in the lumbar region has been posteriorly protruded.

In Figure 5 the column of air can be followed down to the level of the protruded disk and then is seen to stop. Less frequently the line of air curves around the protrusion. As in all roentgenographic studies of the spine, especially those in which air is used as a contrast medium, the defects are seen much better when the films are studied stereoscopically.

A review has been made of the epidurograms and myelograms made at this hospital with a hope of finding some index of their relative diagnostic worth. One method of comparison concerned the estimation of the number of cases by which the roentgenologic diagnosis could be made by air studies alone, without the subsequent use of lipiodol. In a total of 77 cases so studied it was found that with the epidurogram the defect was accurately demonstrated in 55 per cent, while with the air myelogram the percentage was only 35 per cent.

Perhaps substances other than air can be injected into the epidural space without harm, substances which will afford a better contrast but might not be used safely in the subarachnoid space. Investigations on this possibility are in progress.

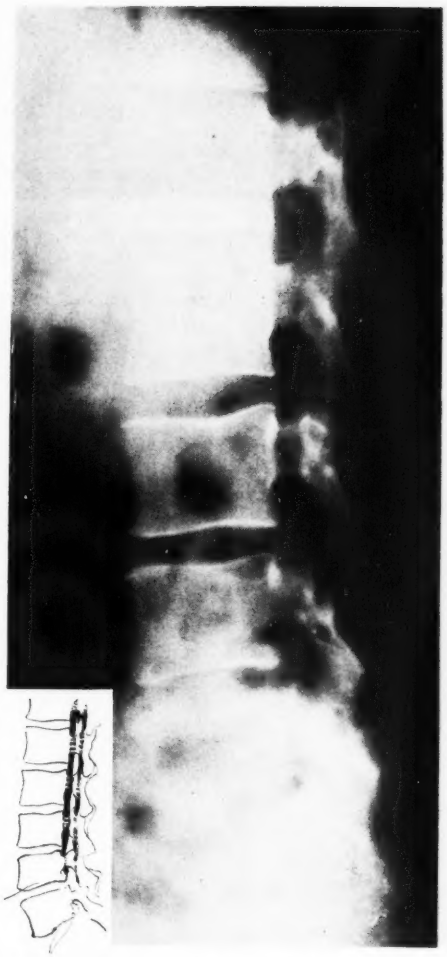

Fig. 5. Epidurogram of a patient with protrusion of the fourth lumbar intervertebral disk.

SUMMARY

A preliminary report is presented of a new method of roentgenographic visualization of protruded intervertebral disks in the lumbar area. The method differs from previous ones in that it utilizes the epidural space for the injection of the contrast medium. This space is the logical one for the purpose, as it is the area into which the disks are directly protruded. Its anatomical characteristics are fortunately adapted for the procedure, in that it does not communicate with either the subarachnoid space or the cranial cavity. Thus air introduced into the epidural space does not enter the cranial cavity, and the headache and period of incapacitation following the subarachnoid injection of air are eliminated. The patients can be seen for further studies the same day, without delay. The method is also diagnostically more accurate than subarachnoid air myelography, the percentage accuracy of the two methods being 55 and 35, respectively, in 77 cases.

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THE INDUCTION OF MULTIPOLAR CELL DIVISION WITH X-RAYS AND ITS POSSIBLE SIGNIFICANCE[1]

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THERE is in the field of radiology what appears to be a most interesting paradox. Radiation, such as x-rays and gamma rays, acts on living matter in one case to cause cell death and in another to cause neoplastic or malignant growth.

While this is well known, almost nothing is known pertaining to the question of how radiation—essentially a destructive agent—operates to cause such opposite effects. Hence, any information that may be brought to bear upon the nature of these reactions is of prime importance. The discussion of such information leads naturally to a consideration of the mechanism of action involved and also to certain considerations of tumor etiology.

During the past few years, it has been my privilege to subject various kinds of sperm and ova to the action of x-rays and to observe alterations in the processes of fertilization, cell division, and development. In this paper I shall describe certain abnormalities in cell division, which it is believed have some bearing on the apparent paradox just mentioned.

During the mid-summer months at certain marine stations male and female sea urchins (*Arbacia punctulata*) are available in abundance and from these sperm and eggs can be obtained in great numbers. When sperm in suitable dilutions of sea water are placed in a vessel containing egg suspension, the eggs become fertilized and development begins. Normally, under the usual laboratory conditions, division of the fertilized egg occurs in about an hour, practically 100 per cent of the cells dividing to form two equal blastomeres (Fig. 1). If, however, radiation is applied in adequate amounts to either of the gametes before fertilization, the cleavage instead of giving rise to two blastomeres will give rise to several (Fig. 2).[2] Details of the experimental procedure and the exact conditions of the experiment have been given elsewhere (1), so that we may proceed directly with analysis of the findings.

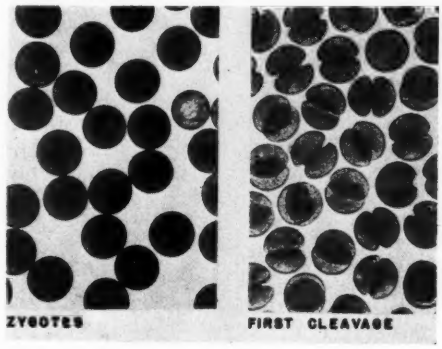

Fig. 1. Photomicrograph showing fertilized eggs (*left*) and the first cleavage (*right*) in *Arbacia punctulata*.

However, before taking up the consequences of multipolar cleavage, let us consider certain facts about the activity which follows the irradiation of gametes.

(1) It is interesting that large doses of radiation do not destroy the motility of sperm nor their ability to stimulate eggs in initiating development. Although doses of 50,000 r and more have been applied to sperm, their swimming action, their entrance into the egg, and the fusion of the sperm and egg pronuclei all take place quite as normally as though no radiation had been applied. Thus, such changes as

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

[2] When this paper was given before the Radiological Society a moving picture was presented at this point, showing both normal and multipolar cleavage in *Arbacia punctulata*.

have been induced by the radiation apparently in no way influence these processes.

(2) It is significant that multipolar cleavage may result from the treatment of either gamete alone. Since the mature sperm cell consists almost exclusively of nuclear material, it appears that multipolar cleavage in all probability results from irradiation changes produced in the nucleus. Moreover, since each of the gametes contains only the haploid complement of chromatin material, it is clear that the influence of the irradiation change is not suppressed or dominated by the normal unaffected complement, a fact which will take on added significance as our analysis continues.

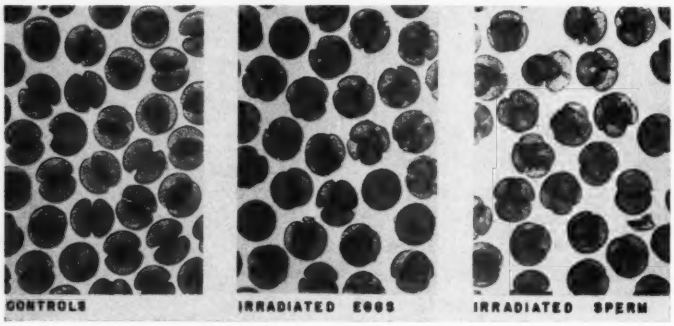

Fig. 2. Photomicrographs showing the first cleavage (*left*) when no radiation had been applied to either gamete; (*middle*) when radiation had been applied to eggs; and (*right*) when radiation had been applied to sperm.

(3) In an attempt to ascertain why multipolar cleavage occurred, sections were made of eggs at various stages during the first cleavage cycle. These were examined first for the appearance of the multipolar spindles (Figs. 3 and 4, bottom row), and it was found that chromatin material which in non-irradiated controls would have been distributed equally to two daughter cells was distributed more or less unevenly among more than two. It is thus apparent that certain of the daughter cells, and probably all, failed to receive a full complement of hereditary materials. The sections were examined next for the first evidence of multipolarity. This was found to occur in the late prophase stage. Ordinarily, two asters arise close together at this stage; these move apart and into the polar regions where they form centers toward which the chromosomes are drawn during mitosis. In the zygotes whose sperm or ova had received large doses of radiation, however, more than two asters appeared (Figs. 3 and 4, top row). These formed accessory poles and the chromatin materials were drawn, not to two poles as normally, but to more than two. This then leads to multipolar cleavage and the formation of cells with less than the normal component of hereditary elements as already described. To reason again from the fact that multipolar cleavage may result from the irradiation of sperm alone and that sperm consist mainly of nuclear material, the findings suggest that radiation produces a change in the nuclear elements which affects the formation of accessory asters and that these in turn are responsible for multipolar cell division and cells with chromatin alterations.

In order to appreciate the significance of chromatin deficiencies, it is necessary to take into account our present knowledge of the nature of development. So far as is known there are but two kinds of factors which act to determine the destiny of cells: the first, environment—physico-chemical surroundings, position, location, etc.—and the second, hereditary materials.

The significance of environment may be indicated by a simple illustration. Take, for example, the fertilized egg of an organ-

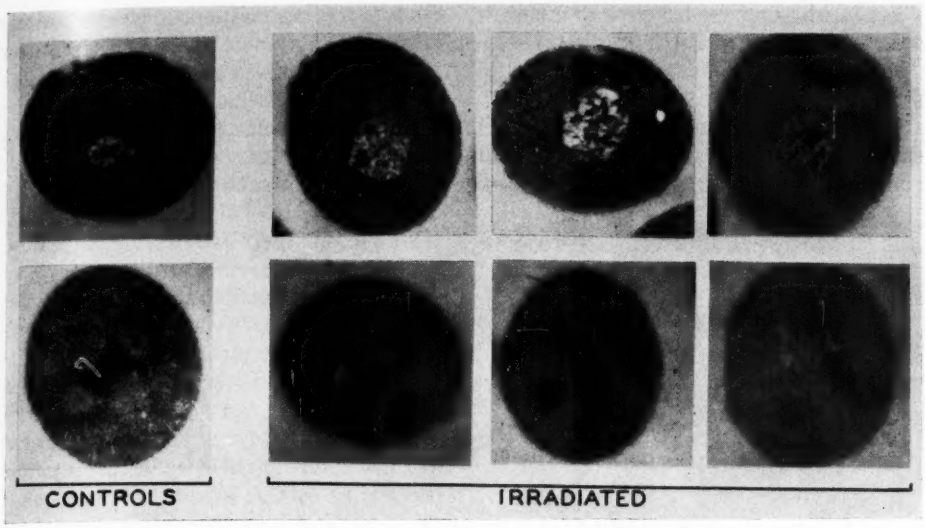

Fig. 3. Sections of eggs showing normal and multipolar cleavage.

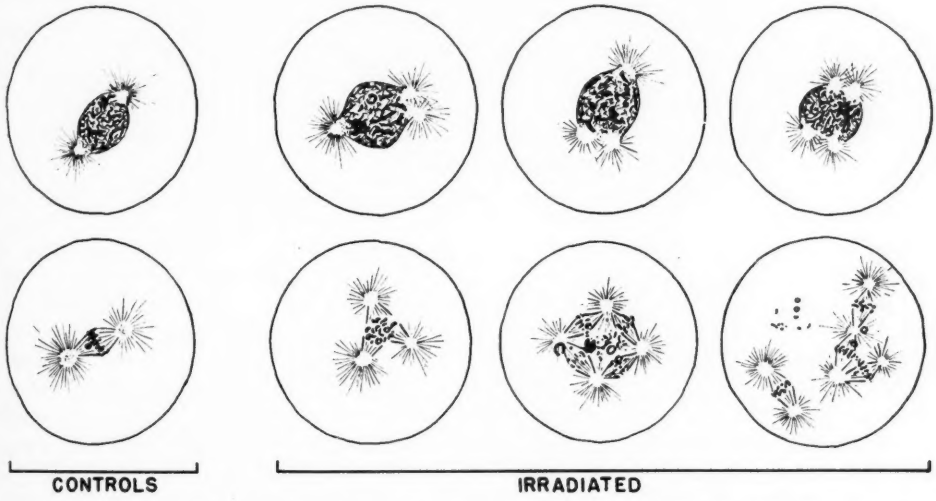

Fig. 4. Composite drawings made from the serial sections of the specimens shown in Figure 3.

ism which has bilateral symmetry, such as a frog. This egg will divide into two equal blastomeres (Fig. 5). Both of these cells proliferate and in a general way each gives rise to half an adult organism. Thus, from the moment of the first cleavage it is possible to say that the cell progeny of one blastomere is destined to give rise to the organs of one part of the body and those of the other blastomere to the organs of the other parts. Similarly, with the four-celled embryo (Fig. 5): the right anterior cell will, in general, give rise to one quadrant of the adult form, the right posterior cell will give rise to another quadrant and so on.

While it is going beyond the facts somewhat to say that any one cell at the two-

cell stage will give rise to one-half an adult, or that any one cell in the four-cell stage will give rise to a quadrant, it is nevertheless true that these cells do not normally have duplicate functions—otherwise each half or quadrant would be identical instead of being right and left, anterior and

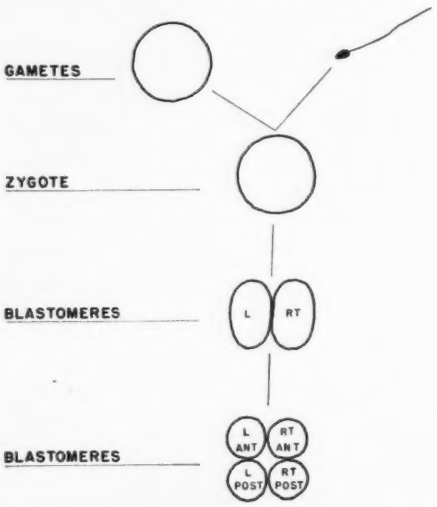

Fig. 5. Diagram showing typical fertilization and early cleavage in some forms.

posterior, dorsal and ventral, etc. That location or position is responsible for this differentiation is made evident by the fact that, if carefully separated at these early stages, each cell may give rise to a complete adult organism. From this it is evident that environment is one of the factors that determine the fate of cells.

Consider now the hereditary elements. These are believed to be specific entities located in linear arrangement along the chromosomes in a manner resembling beads on a string (Fig. 6). Each entity, or gene, presumably different from every other, may exert an influence on the course of life. From purely *a priori* reasoning, it is apparent that the complete regulative potencies for all cell functions of an organism are present in the fertilized egg. By some kind of synthesis, which occurs along with mitosis, these are multiplied and passed along to the cell progeny. Somewhat of an enigma is encountered, however, when it is remembered that the same hereditary complex is received by all of the cells in early development. Some sort of explanation must be given, therefore, for the differing behavior among cells which results in differentiation and the so-called "physiological division of labor."

At present there are two views as to how differentiation occurs. According to the first, it is believed that all cells are totipotent—that is, that every cell in the organism at every stage in the life of the organism contains the full hereditary complex. In such an event, the various genes would be called forth in an orderly manner to exert their influence in guiding the course of development. According to the second view, the cells are not totipotent—in other words, as development proceeds there is an orderly deletion or loss of chromatin material which permits or causes the various specialized cells to follow a particular pattern of development and existence. Much work has been done in the field of experimental embryology in order that a satisfactory choice might be made between these two possibilities, and it appears from the works of Harrison, Spemann, Schotte and others (see especially Schotte, 2) that the first view more nearly applies. Numerous experiments have shown that cells located in a particular region of an embryo, and thereby destined to give rise to a particular tissue or organ, can be removed surgically to another position, where they will give rise to quite a different tissue or organ. Such results tend to suggest that all cells, except perhaps the most specialized adult ones, are totipotent so far as the hereditary complex is concerned. Even the very specialized adult cells can be shown, by placing them in different physiological fields, usually to contain inherent unexpressed capacities. Recognizing, then, the view that most cells, even in complex adult organisms, contain a high degree of totipotency, it becomes an easy matter to point out the possible far-reaching consequences of multipolar cell division.

As indicated above, it is clear that some if not all of the cells resulting from multipolar cell division are deficient in hereditary elements, parts or whole chromosomes being absent. In view of the fact that certain vital genes may have been lost, it is to be expected that such cells are doomed to an early death. Demerec (3), for example, has indicated recently that loss of as little as one-fiftieth of a chromosome in Drosophila is lethal. In cells where multipolar cleavage has been induced by one means or another, the daughter cells may continue to proliferate for a time but usually all die before many divisions have occurred. The induction of multipolar cell division, therefore, may be pointed out as one method, although perhaps not the most important, by which radiation produces death in cells.

But, whereas this offers a means of explaining how x-rays may kill cells by first causing multipolar cleavage, we have yet to offer some explanation of how multipolar cleavage may lead to malignant growth. In an attempt to do this, let us first consider some of the present impressions of the nature of cancer.

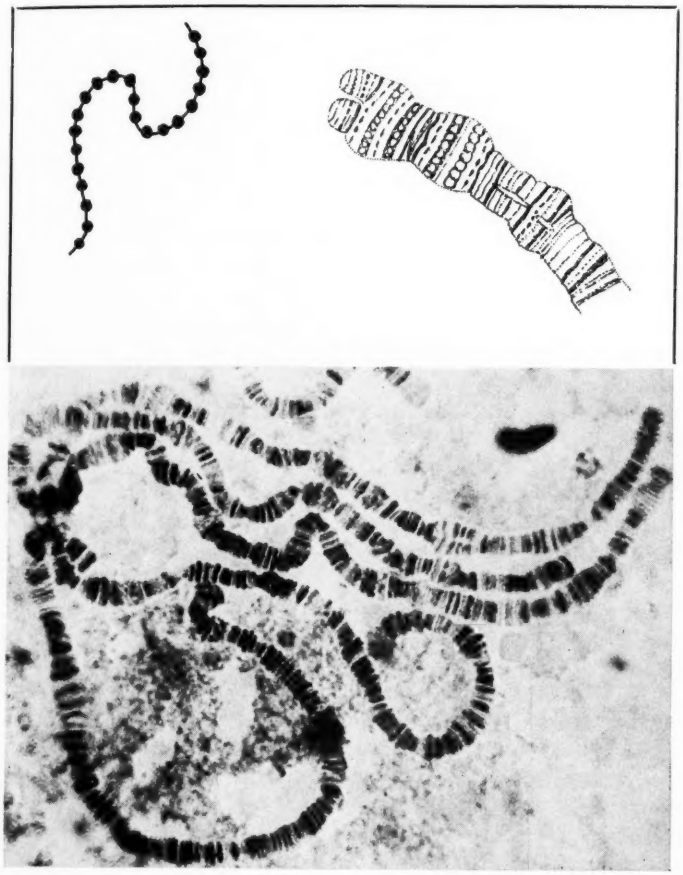

Fig. 6. Diagram, drawing, and photomicrograph of *Drosophila melanogaster* salivary gland chromosomes.

The change from a normal to a malignant cell in some respects resembles somatic mutation. This is true since the malignant cell is distinctly different from its

cell of origin and appears to retain its new characteristics more or less permanently. Could it be proved with certainty that cancer does result from somatic mutation, our task would be an easy one, for it is quite possible that occasionally, by the mechanism of multipolar cell division, just that deletion of chromatin material would be obtained which would remove certain restraining influences and permit unlimited growth. Unfortunately, however, there are objections to the somatic mutation idea, at least as ordinarily set forth. The remainder of our task, therefore, is one of presenting the objections to the simple somatic mutation idea of cancer, yet at the same time showing that the hereditary elements of cells in all probability do have a rôle in the etiology of malignant growth.

Continuing with the idea that a great many, if not all, of the adult somatic cells are totipotent, and that cancer may result from the loss or alteration of certain hereditary substances, some difficult developments are encountered so far as the somatic mutation theory of cancer is concerned. Mutation, as generally understood, occurs at random among cells and also among genes. Hence, under the influence of a mutation-inducing agent it would seem unlikely that any two cells or any group of cells in the same neighborhood would experience just the same kind of change or mutation. From this it appears that if neoplasms are to arise through somatic mutation, they must arise from single cells—in other words, they must arise from the single cell which experienced a change that permits or causes malignant growth.

It seems plain, however, that in certain cases at least, tumors do not arise from single cells. Loeb (4), for example, has pointed out that "whereas the place of carcinoma formation is more or less localized and not general, nevertheless in vagina and cervix, as well as mammary gland, it can be demonstrated that a malignant tumor does not start from a single transformed cell . . . but from larger structures such as ducts and acini or certain areas of the surface epithelium." Two other lines of evidence oppose the idea of single cell origin and accordingly the idea of somatic mutation in the usual sense: (1) carcinogens injected into the blood stream of mice cause the development of carcinomatous lung nodules arising at multiple foci at about the same time (5); (2) carcinogens injected subcutaneously sometimes produce mixed tumors at the site of origin—tumors that are made up of different tissue elements such as muscle and connective tissue (6). It is quite clear that the various lung nodules did not arise from the same cell of origin and similarly in case of the mixed tumors that the two kinds of tissue in all probability did not arise from the same cell.

Whereas these examples cast doubt on the validity of the somatic mutation theory of cancer as such, they actually do not preclude it if we take into account one other interesting possibility. The idea that tumor cells arising by somatic mutation must stem from a single cell apparently comes from our present knowledge of mutations, which, it seems, is based largely upon impressions obtained from spontaneous and x-ray-induced changes. Spontaneous mutations occur at random among cells and at random among the genic elements of a cell, presumably through accidental happenings of various kinds. X-ray-induced mutations occur at random in the same way, but in this case the reason for the randomness is more obvious. Radiation particles or quanta act discretely on matter, producing small islands of change throughout the treated mass. Thus, the randomness of x-ray-induced mutations is due to the random distribution of the radiation. We raise the question, therefore, whether the induction of mutations is always at random. Is it not possible that other agents, such as specific drugs, may act selectively on the genic elements? Does it not seem that carcinogens may do precisely this? May they not induce changes in a cell, or perhaps a group of cells, that cause the cell progeny to

behave as though a somatic mutation had been produced? At present there is practically no information available regarding the kind of changes induced in cells by carcinogens. But it is possible, nevertheless, to point out some reasons for believing that the idea of selective mutation in the induction of cancer is plausible.

As indicated above, cells have certain inherent capacities for various types of activity; and further, the particular activity a cell will manifest depends on the influence exerted by environment on the hereditary mechanism. Whereas it was pointed out above that position and location of a cell in the early blastula and the position and location of a group of cells in later development may have everything to do with the fate of cells and the cell progeny, it is necessary here to go farther and indicate that chemical agents form what is perhaps the more important part of the environment. Parenthetically, it should be understood that by environment is meant anything which acts to stimulate dormant genes or to incite them to activity; environmental factors, therefore, may lie within the cell as well as without. It is now well known that certain chemical substances, called organizers, are present during development which act to call forth very specific cell behavior. Likewise, it is well known that chemical agents, such as hormones, growth substances, and the like, present in the adult bodies of complex organisms call forth very particular cell activities. We need only mention the response of breast tissue to sex hormones to make this point very clear.

The cell at present, therefore, may be pictured as follows: It is a physico-chemical reacting system which contains a vast array of hereditary factors that guide it and its progeny along particular channels of activity. The pattern of activity which the cell and its progeny will follow appears, however, to depend on the influence of the physico-chemical environment in touching off the various factors to exert their influence on the cell. Thus, while the mechanism seems very complex, it nevertheless seems well ordered.

In a system such as this, then, how does a carcinogenic agent act? In the case of physical agents such as radiation, it is clear that nothing is added to the cell from without—that is, no new chemical compound, only energy. The environmental agent in this case only sets off a mechanism, the physical basis for which was already present. On the other hand, when the inciting agent is a chemical carcinogen which is applied directly to the cell, there is the possibility that something may be added to the cell and it is necessary to take into account the significance this may have. It would seem that chemical carcinogens may act in one of two ways: (1) Molecules of the agent may act as part of the environment inside or outside the cell to call forth inherent cell potencies, as in the case of the physical agents, or (2) the molecules may enter the cell and become associated with the hereditary substances in such a manner as to modify the action of the genes.

Our knowledge of carcinogens is at present limited mainly to the following facts: (1) They must have certain particular chemical characteristics; (2) only a very small quantity is needed to induce malignancy; (3) once malignancy is established the supply of carcinogen does not need to be replenished—at least from external sources. Thus, should the carcinogen have a particular affinity for certain chromatin material, and a few molecules attach themselves at a particular locus on chromosomes in a group of cells, selective somatic mutation would be in effect and the postulation would be in accord with the observed facts. In such a case, if malignancy were accomplished by destroying a restraining gene, it is clear that the matter of replenishment of carcinogen would not enter in; so also, if malignancy were accomplished by the addition of carcinogen molecules to the chromosomes or genes, the matter of replenishment would not enter in, since as a gene it would be synthesized by the cell in the usual way. On the other hand, should the carcinogen exist

as part of the environment, constantly stimulating certain genic action, the carcinogen would have to be constantly replenished—that is, unless in the living system it had the properties of autosynthesis, as does a protein virus

Important to this discussion is the fact that in all of these concepts of cancer, the hereditary materials are in some way involved. But is there not some concept which does not involve the hereditary elements? There is if it be assumed that the carcinogen is propagated like a virus within the cell, is transmitted from mother cell to daughter cell in mitosis, and through its own influence impels the cell to follow along the course of malignancy. Actually there are tumors that appear to be propagated by virus-like substances (*e.g.*, the chicken sarcoma and the rabbit papilloma), but it is not known whether the virus acts directly through its own influences on the cell or indirectly by calling forth certain cell potencies already present.

In this connection, recent experiments on foster nursing are illuminating. It has been found by Bittner (7), Andervont (8). and others that if young mice from a high-breast-cancer strain are foster-nursed on mothers from a low-cancer strain, few or no cancers will develop in the young, and, further, that if young of certain low-cancer strains are foster-nursed on the mothers of high-cancer strains, the incidence of cancer will be considerably increased. This indicates a two-factor cause of cancer—one a proper genetic background and the other some agent in the milk (virus or otherwise). Apparently the milk agent can act only when the genetic background is right. In this case the evidence strongly suggests that the malignancy-inciting agent acts indirectly through its influence in calling into play hereditary factors which would otherwise lie dormant.

To summarize, it is apparent that a great deal of information is available suggesting that the induction of cancer in some way involves changes in the hereditary complex of cells. Thus, since radiation is known to cause cancer and also to disturb the hereditary set-up through the induction of multipolar cleavage, we may point to multipolar cleavage as having possible significance in the production of cancer by radiation.

In conclusion then, the following may be emphasized:

(1) That multipolar cell division usually leads to early death in the cell progeny, since as a rule vital elements are lost.

(2) That multipolar cell division in some cases may give rise to cancer, since losses or modifications of hereditary substances thus produced may give rise to just those changes which support or permit malignant growth.

(3) That as yet there is no record of multipolar cell division actually giving rise to a tumor, although the findings do not preclude this as a possibility.

(4) That the implications derived from the studies on multipolar cell division are of interest because they offer a possible means of explaining how radiation, by the same mechanism of action, may cause cell death on the one hand and malignant growth on the other.

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FRACTURES OF THE VERTEBRAE FOLLOWING METRAZOL THERAPY[1]

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TREATMENT of schizophrenia by production of convulsions was introduced by Meduna (13) in 1935, but since that time its use has been extended to a number of other mental disorders, including the manic-depressive psychoses (25), involutional melancholia, and some of the psychoneuroses (12). At the present time thousands of patients have been treated with the various convulsion-producing drugs, but metrazol (cardiozol) has been by far the most widely used. Except for an occasional death (9, 22, 3), there were no deleterious effects reported for some time, and in these instances postmortem examination revealed the presence of a complicating serious organic disease.

The first reports to mention fractures as a complication of convulsive therapy were those of Stalker (21) in England and Wespi (24) in Switzerland, who reported single instances of vertebral fracture, and of Satta (19) in Italy, who reported two cases of fracture of a femur. One of Satta's patients also sustained a fracture of a humerus. Since then a number of other workers have reported fractures of the long bones, including Müller (15), Walk and Mayer-Gross (23), Beckenstein (1), Hamsa and Bennett (8), Janzen (10), Somers and Richardson (20), and Krause and Scherb (11).

Pollock (17) in reporting a series of 1,140 cases mentions no vertebral fractures, but does call attention to fractures and dislocations of the long bones and of the mandible.

In a statistical study of the results of metrazol therapy, Meduna and Friedman (14) reported 1.1 per cent of "mechanical" complications, exclusive of temporo-mandibular dislocations. Later reports indicate that this figure is far too low.

The most detailed study of vertebral fractures following metrazol treatment thus far reported is that of Polatin (16) and his co-workers. These men reported a group of 58 cases. Fifty-one of these patients were studied roentgenographically at some time following completion of their course of treatment, and in this number 22 fractures were found, an incidence of 43.1 per cent. Most of these fractures occurred in the mid-thoracic region and involved an average of three to four vertebrae. Analyzing the table presented by these authors, it is found that almost one-half of the patients who sustained a fracture did not complain of backache.

Bennett and Fitzpatrick (2) reported 8 mid-thoracic fractures in 17 cases. Hamsa and Bennett (8) reported three mid-thoracic fractures in 800 treatments, but failed to state how many patients this represented. Routine roentgenograms following therapy were not taken in either series.

More recently Dedichen (4) reported 6 fractures in 80 treated cases, all of them in the mid-thoracic vertebrae.

MECHANISM

The exact manner in which these fractures occur is still a matter of some discussion, but their location (almost uniformly a compression of the anterior portions of the mid-thoracic vertebrae) indicates that it is the flexion part of the convulsion which produces the injury.

Roberg (18), in a discussion of the mechanism of fractures of the spine in tetanus, pointed out that the experiments of Erlacher (5) and of Göcke (7) showed that heavy weights were required to alter the

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shape of isolated vertebrae. Göcke also determined the fact that trip-hammer blows delivered in rhythmic succession reduced the elasticity of the bone, so that the vertebra became brittle and lost its initial resistance to pressure. Roberg suggests that this is analogous to the loss of temper which occurs when iron is hammered. Fick (6), using similar methods, found that the fifth thoracic vertebra was the weakest of the entire spine.

Roberg also notes that when fractures occur in the course of tetanus, they are found in the mid-thoracic vertebrae, whereas the location of the fracture follow-

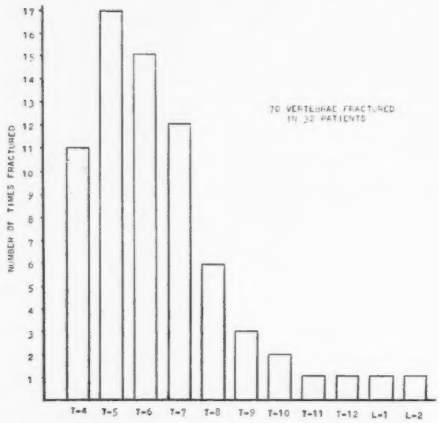


Fig. 1. Site of seventy vertebral fractures following metrazol therapy in thirty-two patients.

ing external trauma is usually in the upper lumbar spine. Almost all of the fractures following convulsions induced by metrazol which have been reported to date, and the cases reported herein, have been in the mid-thoracic vertebrae. Why these vertebrae, otherwise a rare site of fracture, should be so constantly injured in the course of the convulsions has caused some speculation.

The thoracic spine is normally the least mobile portion of the vertebral column, and the vertebral bodies here are smaller than in the lumbar region; at the same time, the action of the powerful anterior trunk muscles on the spine is reinforced in the thoracic region by the anterior abdominal muscles acting through their upper attachments on the ribs (18). This latter action is considerably enhanced by the leverage afforded by the ribs themselves.

TABLE I.—RELATION OF PRE-EXISTING LESIONS OF THE VERTEBRAE TO FRACTURES

	Cases	Fractures
Cases of deforming spondylosis	11	..
With fracture	..	3
Cases of osteoporosis	7	..
With fracture	..	5
Cases of herniation of nucleus pulposus	5	..
With fracture	..	2
Normal spine	52	..
With fracture	..	22

There can, of course, be no exact method of measuring the force of contraction of the anterior trunk muscles, nor of the abdominal muscles, nor of the leverage exerted through the ribs on to the relatively rigid thoracic spine, nor can the rate with which this force is applied be calculated, but it seems evident that a great amount of force is rapidly and repeatedly exerted on the vertebral column, and especially that portion which is the least mobile.

METHOD OF TREATMENT

This report is based upon 75 consecutive cases treated in the Neuropsychiatric Division of Cleveland City Hospital. The diagnoses included schizophrenia, manic-depressive psychoses, involutional melancholia, and psychoneuroses.

The technic employed for metrazol treatment was the standard method in general use. Patients suffering from any debilitating illness, or who were bed-fast, were not given the drug. The injections were given intravenously three mornings a week to fasting patients, in doses of 7.5 grains, this amount being increased only if it failed to produce a convulsion. The patients were placed flat in bed without a pillow or rigid restraint of any kind. They were kept in bed until the postconvulsive confusion had cleared.

In order to determine the presence of any antecedent fracture, or of any abnormality which might contraindicate the use of metrazol, a routine lateral roentgenogram of the lumbo-thoracic spine was taken before

Fig. 2. Lateral view of the mid-thoracic spine following therapy. Seven convulsions were induced before the patient complained of pain. The arrow points to a slight compression fracture of the upper border of the sixth thoracic vertebra.

Fig. 3. Lateral view of mid-thoracic spine of patient who did not complain of pain following therapy. The fourth to eighth thoracic vertebrae are fractured. Although the compression in any one vertebral body is not great, there is a definite kyphosis as the result of the combined deformities.

therapy was begun. All patients were again studied roentgenographically after completion of the course of treatment. If at any time they complained of back pain during the course, a roentgenogram was taken before any more convulsions were induced. Treatment was, of course, discontinued as soon as the diagnosis of a fracture was made.

RESULTS

Thirty-two of this group of 75 patients, sustained a fracture of one or more vertebrae, an incidence of 42.6 per cent. There were 33 males, of whom 19 (57.5 per cent) suffered a fracture, and 42 females of whom 13 (30.9 per cent) were found to have a fracture. The average age of patients with fracture was thirty-one, and of those who escaped fracture, thirty-five years.

The average number of convulsions was not tabulated since it was not regarded as significant, in view of the fact that treatment was stopped as soon as a fracture was diagnosed, sometimes after only one or two treatments.

As demonstrated in Figure 1, the most frequent site of these fractures was the mid-thoracic spine. A total of 70 vertebrae were fractured in these 32 patients, or an average of slightly more than two per patient. Five patients sustained fractures of four or five vertebral bodies. Sixty-eight of the fractured vertebrae were thoracic, two were lumbar.

Only 20 of the 32 patients with fractures complained of back pain. This is in accord with the experience of Polatin and his coworkers. In addition there were 12 patients who complained of backache, but who showed no roentgen evidence of a fracture.

An attempt was made to correlate the incidence of the fractures with the presence or absence of pre-existing disease of the vertebral column. From Table I it can be seen that patients who possessed what was

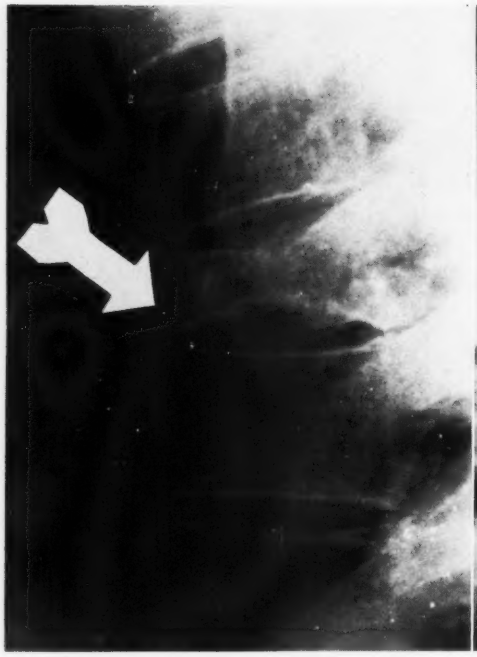


Fig. 4. Lateral view of the thoracic spine centered on the sixth thoracic vertebra, which is the seat of a severe compression fracture following therapy. This patient showed definite roentgenologic evidence of osteoporosis.

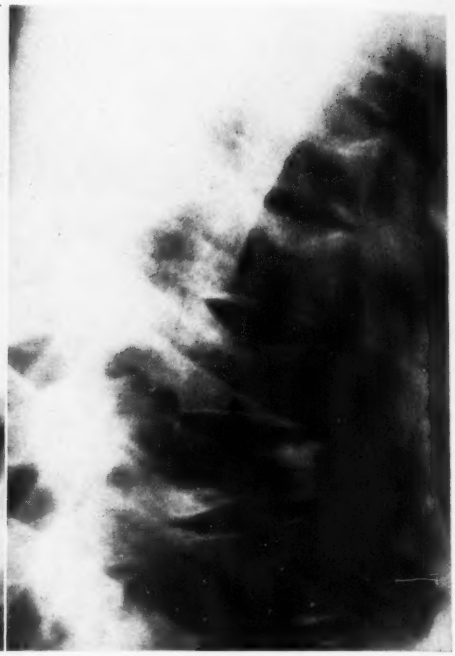


Fig. 5. Lateral view of the thoracic spine following therapy. This patient sustained fractures of the fourth, fifth, sixth, and seventh vertebral bodies. In spite of the severe compression the patient did not complain of back pain.

roentgenologically considered to be a normal back were just as likely to sustain a fracture as were other members of the group. There was but one exception to this, a group of 7 patients who were considered to have osteoporosis. Five of these latter sustained a fracture. Although this is a very small number of cases, and is not statistically significant, it seems that osteoporosis may be a contraindication to the use of metrazol.

From the data presented, it is clear that routine roentgenograms should be taken before and after the use of metrazol therapy. In this manner, cases of osteoporosis can be excluded from any group to be treated, and asymptomatic fractures can be diagnosed.

The degree of deformity caused by these vertebral fractures was as follows:

Minimal deformity	13
Moderate deformity	9
Severe compression	10

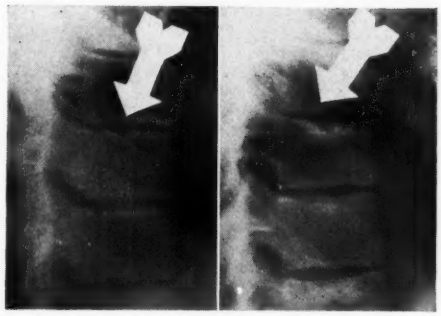
As previously noted, almost all of the fractures were compressions of the anterior portions of the vertebral bodies. There were a few instances, however, in which the fracture was due to the intrusion of the nucleus pulposus of the intervertebral disc through what appeared to be a normal superior vertebral surface, and also two fractures through previously existing Schmorl nodes. Examples of the varying degrees and types of fractures are seen in Figures 2 to 7.

There were no deaths in this series, and none of the patients presented neurologic evidence of compression of the spinal cord. Consultation with the Fracture Service was obtained on all patients, and the treatment was in accordance with the recommendations submitted.

COMMENT

The extremely high percentage (42.6 per cent) of fractures in a large series of carefully observed cases treated with metrazol

is a matter of great importance. The merits and disadvantages of any therapeutic agent must be carefully evaluated, and if the injurious effects outweigh the benefits obtained, any method of treatment should be discarded. That metrazol produces a large number of serious complications seems to be beyond question. When to this fact is added the knowledge that the efficacy of the treatment is not yet beyond dispute, and that writers on the subject agree that a certain percentage of the patients treated will show no response, and when, further, it is realized that another group of appreciable size will show spontaneous remission without specific therapy, it is a grave question as to whether or not metrazol therapy should be continued. Therefore, until a safer method of administration can be developed, the use of metrazol at Cleveland City Hospital has been limited to carefully selected cases of long-standing, rigid, mid-life depression and of involutional melancholia which have failed to respond to other methods of therapy. Perhaps a drug such as curare, which acts on the muscle-nerve end plate, might obviate a number of these fractures.



Figs. 6 and 7. Lateral view of the lower thoracic spine before (left) and after (right) therapy. The arrows point to the upper border of the tenth thoracic vertebra. In the figure to the right note the cupped indentation in the upper border. This was not present before therapy and represents a fracture of the upper surface of the vertebra due to a herniation of the nucleus pulposus of the intervertebral disc into the vertebral body. Example of a Schmorl node due to trauma.

CONCLUSIONS

1. The available literature has been reviewed and the incidence of fractures of the vertebrae following metrazol therapy as reported by different authors has been noted.

2. An attempt is made to explain the manner in which these fractures occur, and the reason they are found so frequently in the mid-thoracic spine.

3. Seventy-five consecutive cases were studied with routine lateral roentgenograms of the thoraco-lumbar spine before and after metrazol therapy. Thirty-two of these patients, or 42.6 per cent, sustained fractures of one or more vertebrae, involving a total of 70 vertebral bodies.

4. The most common site of these fractures was in the mid-thoracic vertebrae. The fourth, fifth, sixth, and seventh bodies were the most frequently damaged.

5. Routine lateral roentgenograms of the spine are recommended before metrazol therapy is begun to discover the presence of any contraindications, and after treatment to diagnose asymptomatic fractures.

6. Osteoporosis appears to be a contraindication to the use of metrazol.

7. As a result of this study, the use of metrazol has been restricted to carefully selected cases until a safer method of handling patients can be developed. Curare, or a similar drug, is suggested as a possible agent to prevent these fractures.

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FURTHER STUDIES OF THE SHOULDER JOINT WITH SPECIAL REFERENCE TO THE BICIPITAL GROOVE[1]

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OUR roentgenographic studies of the shoulder joint have convinced us that many lesions have been overlooked because of inadequate x-ray examination (1). In a former paper, we suggested that a routine x-ray examination of the shoulder should consist of an anteroposterior projection with the humerus in external rotation, preferably with a cephalocaudad angle of 15 degrees, and an anteroposterior projection with the humerus in marked internal rotation (2). It is impossible, however, to obtain any satisfactory information regarding the region of the bicipital groove from the above projections. Accordingly, we have devised a tangential projection for demonstrating that portion of the humeral head. This view is obtained by the following technic (see Fig. 1, *A*, *B*, *C*):

1. Patient supine.
2. Arm adducted and supinated.
3. Cassette on top of shoulder and at right angles to the longitudinal axis of humerus.
4. Tube slightly external to and below elbow.
5. Central ray tangential to bicipital groove. The exact angulation varies with the thickness of the patient, but the tube is angled medially approximately from 25 to 30 degrees and ventrally from about 10 to 15 degrees.

In an alternative technic the first three steps are the same as above. The fourth and fifth are as follows:

4. Tube ventral to chest and mesial to shoulder.
5. Central ray tangential to bicipital groove; tube angled laterally from 25 to 30 degrees and dorsally from 35 to 40 degrees.

This latter technic has been practically discarded because in this projection there is troublesome distortion of the outlines of the groove and tuberosities (see Fig. 1-*D*) and if the angle of the tube is not exactly correct, the groove is entirely missed.

NORMAL ROENTGENOGRAPHIC ANATOMY OF THE BICIPITAL GROOVE

Our tangential projection (see Fig. 1-*C*) shows a smoothly bordered, notch-like indentation in or near the middle of the outline of the articular surface of the humeral head. Its size varies directly with the diameter of the head of the humerus. The greater and lesser tuberosities are represented by a smooth prominence on each side of the groove; the lesser tuberosity is medial in position, it projects further ventrally, and its wall bordering the groove is more perpendicular than is that of the greater tuberosity. This anatomical difference in the tuberosities, especially in grooves of shallow depth, probably accounts for the fact that most tendon dislocations occur laterally on the greater tuberosity.

PATHOLOGIC CHANGES IN THE BICIPITAL GROOVE REGION

Our cases are limited to patients with a history of previous trauma to the shoulder and ensuing shoulder pain, whose routine x-ray studies were negative. We made special tangential views on 40 such patients and in no instance was a normal groove depicted. Instead of a smoothly bordered

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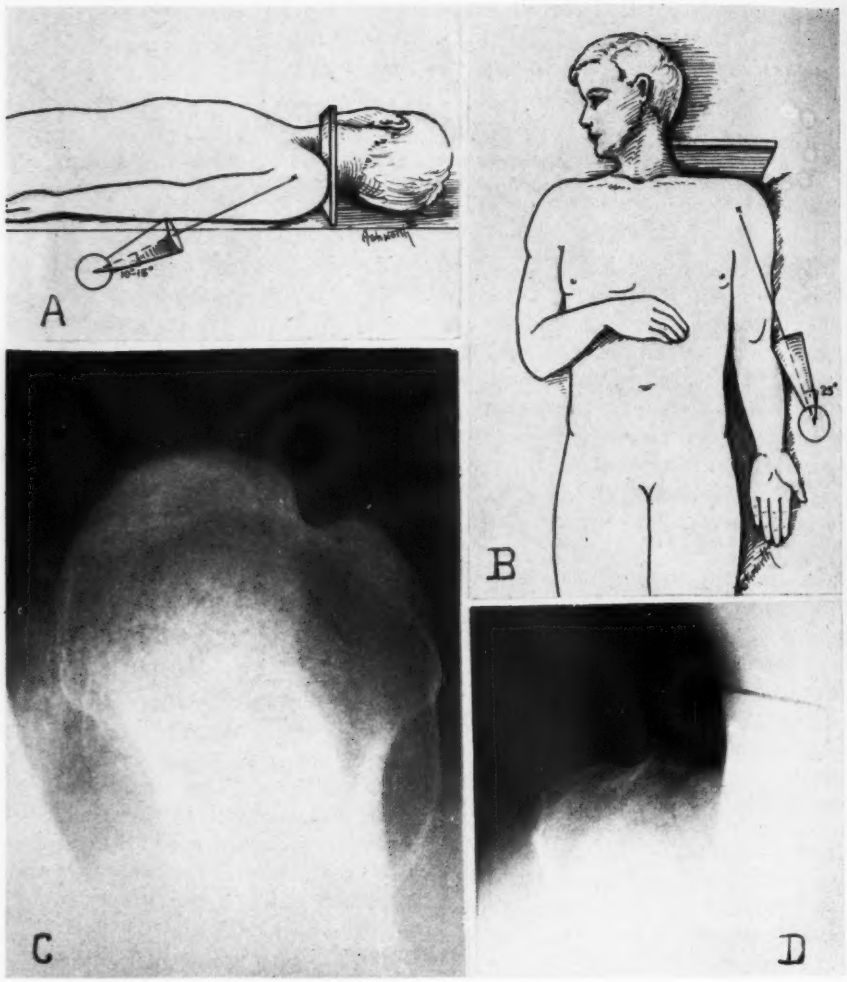

Fig. 1. *A* and *B*. Diagrams illustrating the bicipital groove technic.
C. Roentgenogram of normal groove—left humerus—approved method. The smooth indentation is the bicipital groove, the medial wall is steeper than the lateral, the lesser tuberosity is more prominent than the greater tuberosity, and the contours of both tuberosities are smooth.
D. Roentgenogram of normal groove—right humerus—discarded method.

groove with normal tuberosities, we have discovered one or more of the following changes:

1. The bicipital groove may be shallower, deeper, or wider than its fellow.
2. Not infrequently there is an additional groove present which we believe is due to a dislocation of the tendon of the long head of the biceps (4).
3. When a new groove is formed, it is most often located lateral to the original groove. It is of less depth than the original groove even though the latter tends to fill in with new bone as a result of disuse.
4. The most common abnormality is an irregularity of the outline of the groove. In addition a small osteophytic spur is occasionally noted projecting laterally from the lesser

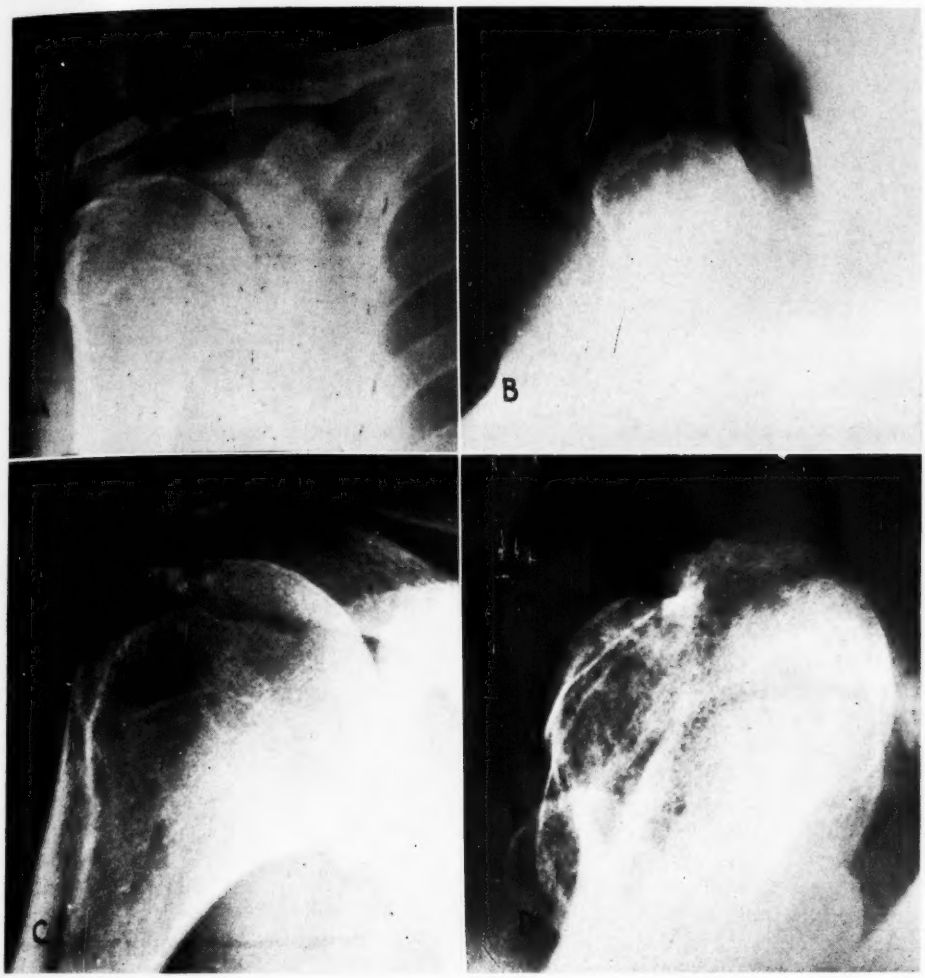

Fig. 2. *A*. Case 1: Anteroposterior film of right shoulder in external rotation, showing slight irregularities in the region of the bicipital groove suggestive of arthritis. *B*. Case 1: Bicipital groove projection of right humerus. Note the new groove lateral to the original bicipital groove; the latter is more shallow than normal and on the original film its outlines appear somewhat distorted. The irregularity of the outline of the greater tuberosity in 2-*A* is due to the sharp ridge separating the two grooves.
C. Case 2: Anteroposterior view of right shoulder in external rotation, normal in appearance. *D*. Case 2: Bicipital groove projection revealing two shallow notches on the lesser tuberosity; the original bicipital groove appears narrowed and its base sclerotic.

tuberosity border of the groove at the site of capsular attachment. The shadow of the largest spur in our series measured 7 mm. in length (uncorrected). It is undoubtedly true that serration of the groove or spur formation results in fraying of the bicipital tendon (3, 5, 6, 7).

5. Linear areas of calcification in the soft tissues lateral to the greater tuberosity and probably in the tendons of the external rotator muscles have been noted as an incidental finding in some cases.

CASE REPORTS

We present 4 of the 40 cases studied in order to illustrate the anatomical changes

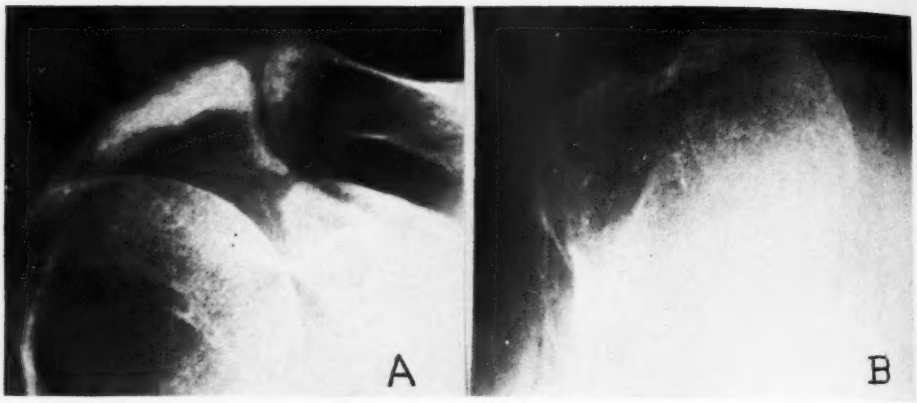

Fig. 3. Case 3: *A*. Anteroposterior view of right humerus in external rotation, revealing a very slight irregularity of the outlines of the tuberosities which is of questionable significance.
B. Bicipital groove projection, showing a scalloping of the outline of the greater tuberosity presumably due to attrition by bicipital tendon. A large spur projects laterally from the mesial wall of the bicipital groove.

that occur in and about the bicipital groove.

Case 1.—G. H., a 52-year-old male, felt a sudden sharp pain in his left shoulder while tossing a railroad tie on May 4, 1937. Thereafter he had noted a snapping sensation on movement and the shoulder had been weak. Routine x-ray examination was negative.

Examination on Nov. 15, 1939, revealed a palpable, tender tumor in the bicipital groove, a rupture of the long head of the biceps, and atrophy of the deltoid muscle. Abduction was limited to 45 degrees and almost all movements caused pain. A routine roentgenogram (Fig. 2-*A*) appeared negative aside from a suggestion of arthritic changes of the greater tuberosity. A tangential view (Fig. 2-*B*) revealed a large second groove on the greater tuberosity. The original groove appeared shallow and there was calcification in the tendons of the external rotator muscles. The opposite shoulder was negative.

Case 2.—J. M., a 59-year-old male, was struck on the right shoulder during November, 1938. Pain persisted in this shoulder for a year. Examination on Nov. 25, 1939, revealed pain on palpation over the groove. Rotation and abduction were slightly limited. Routine roentgenography (Fig. 2-*C*) showed no gross abnormality. Bicipital groove projection (Fig. 2-*D*) showed narrowing of the original groove, sclerosis of its walls, and a double notching on the *lesser* tuberosity (unsuccessful attempts at formation of a new groove?). The opposite shoulder was normal.

Case 3.—T. J., a 50-year-old male, in February, 1939, twisted his right shoulder. Examination on Dec. 13, 1939, revealed an intact biceps with tenderness of the long head. Abduction was limited to 40 degrees. Routine roentgen study was negative (Fig. 3-*A*). Tangential projections of the groove revealed scalloping of the greater tuberosity and a large spur projecting into the groove from the lesser tuberosity; calcification in the external rotator group is noted (Fig. 3-*B*).

Case 4.—A. A., a 64-year-old male, had experienced recurrent dislocations of both shoulders during the past five years. Shoulder pain had been constant. Examination revealed limited flexion and abduction and the long head of the biceps was torn on each side (Fig. 4-*B*). Routine x-ray examination was negative. A tangential view of the anterior portion of each humeral head revealed markedly flattened or filled-in grooves, the outlines of the

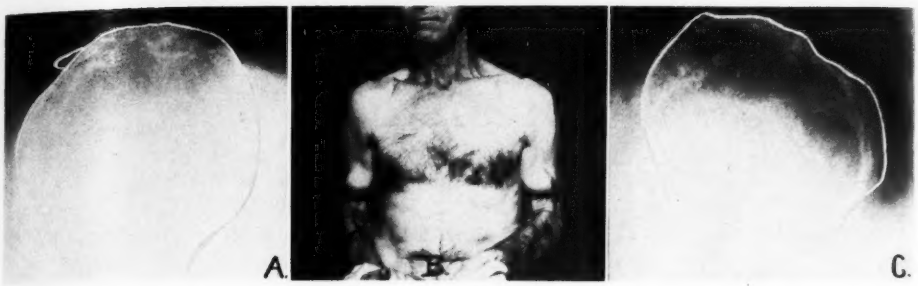

Fig. 4. Case 4: *B*. Both forearms in flexion; bulging of biceps muscles due to tears of the tendons. *A* and *C*. Right and left humerus, respectively—bicipital groove projections—showing flattening and irregularity of the outlines of the greater tuberosities and large spur projecting laterally from lesser tuberosity of right humerus.

tuberosities were slightly irregular, and a spur projected laterally from the region of the right lesser tuberosity (Figs. 4-*A* and 4-*C*).

SUMMARY AND CONCLUSIONS

1. The routine projections of the shoulder ordinarily used fail to demonstrate most of the bony changes occurring in the region of the bicipital groove.[2] A technic for demonstration of this groove is described.

2. The normal and pathologic roentgenographic findings are discussed.

3. Cases are presented which exhibit some of the more common pathologic conditions, such as change in the size of the groove, additional groove formation, and irregularity of the outline of the margins of this region.

4. Further correlation of the clinical and roentgen findings is necessary in order to determine more accurately the clinical significance of these abnormalities.

[2] We have experimented briefly with the film-holder devised by Cleaves (Cleaves, E. N.: A New Film Holder for Roentgen Examination of the Shoulder. Am. J. Roentgenol. **45:** 288–290, February, 1941) for obtaining a supero-inferior view of the shoulder. It is possible to obtain a diagnostic view of the bicipital groove of the humerus with this device if the proper angle of projection for each case is first determined by means of fluoroscopy.

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A NEW ROENTGEN SIGN OF PYLORIC OBSTRUCTION: THE ROENTGEN VISUALIZATION OF THE STOMACH WITHOUT THE USE OF CONTRAST MEDIA[1]

By MAURICE FELDMAN, M.D., *Baltimore, Maryland*

THIN-WALLED hollow viscera of the abdomen are not as a rule visible without the use of contrast media, unless there is a marked pathological thickening of the wall, or it is outlined by gas. In recent years there has been considerable refinement in roentgen technic, tending to produce clearer roentgenograms, thus enabling the roentgenologist to visualize the soft tissues with greater clarity.

In a preliminary roentgenogram made of the abdomen in the prone or supine position, the cardia of the stomach is commonly observed to be outlined by gas, less frequently by a combination of fluid and gas, and rarely by a dense homogeneous shadow. The cardia is normally visualized as a smooth, rounded shadow, without clinical significance.

Practically nothing has appeared in the literature on the subject of visualization of the normal cardia in the preliminary roentgenogram. More recently Nathanson has directed attention to the fundus of the stomach, which frequently casts a dense shadow resembling a soft-tissue tumor. When air is observed within this shadow, its identification is made with ease, but when the shadow is solid, the picture mimics a neoplastic mass, from which differentiation may be difficult unless barium or air is introduced into the stomach. The fundal shadow varies in size, is usually rounded, and lies beneath the diaphragm, in the mesial aspect close to the spinal column. The shadow may be homogeneous, resembling a solid tumor, or may show a small amount of air in its center.

The visualization of air in the cardia of the stomach is a common normal roentgen observation. After administration of a barium meal, especially in the supine position, the cardia will often be seen as a rounded ball in the left upper quadrant. Under the fluoroscope the shadow is movable and compressible. The contour of the rounded shadow may be seen to change during a peristaltic wave. It may be observed in all types of stomachs, but is more commonly seen in the cowhorn and cascade types, and is accentuated by compression of the stomach against the vertebral column. The shadow moves with respiration, when it can be seen to separate from the diaphragm. It has no connection with any of the solid organs demonstrable radiographically on the left side. The roentgenogram will clearly show distinct outlines of the spleen and kidney, in addition to the stomach shadow.

Contour shadows of the cardia of the stomach, which are a well recognized normal finding, should not be confused with the visualization of the entire stomach without contrast media. The latter roentgen sign has not previously been recognized as having any clinical significance. Preliminary roentgenograms of the abdomen may reveal the outline of the entire stomach, together with the adjacent solid organs. When the whole gastric contour is visible, it usually indicates the presence of an excessive amount of fluid in the stomach. If air is present in the cardia it may give a clue as to the true nature of the shadow. In some cases, however, with an excessive amount of fluid, air may be absent altogether and the whole stomach may thus be visible as a solid organ. The fluid may be due to partaking of water or a large meal before the examination, but in a fasting state visualization of the entire gastric shadow is indicative of gastric retention due to a pyloric obstruction. The radiologic visualization of the entire stomach thus represents a

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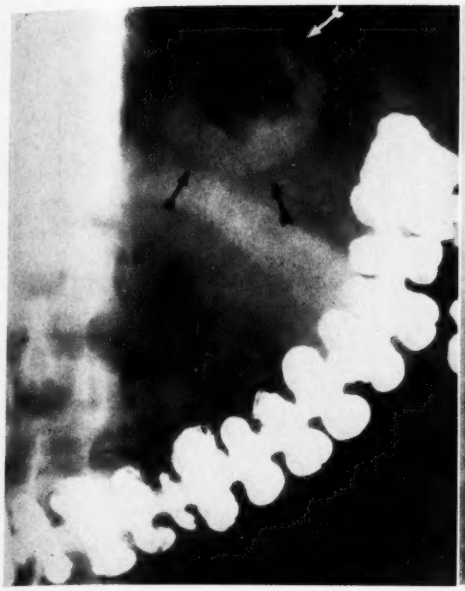

Fig. 1. Dense rounded shadow of the cardia of the stomach, before the administration of barium. Note the presence of gas in the center of the shadow.

Fig. 2. Large smooth rounded homogeneous shadow in the mesial aspect of the left upper quadrant, just beneath the diaphragm, representing fluid in the cardia of the stomach.

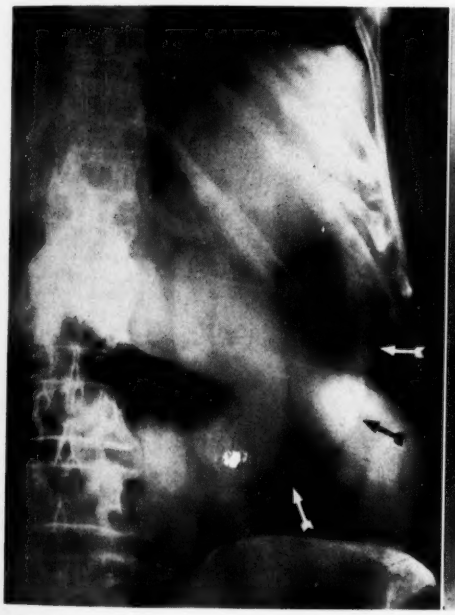

Fig. 3. Large soft-tissue shadow of smooth outline indicated by arrows, representing an excessive amount of fluid in the stomach, in a case of pyloric obstruction. No air is to be seen in the cardia. A small kidney and the psoas muscle are clearly shown. (Roentgenogram from Sinai Hospital.)

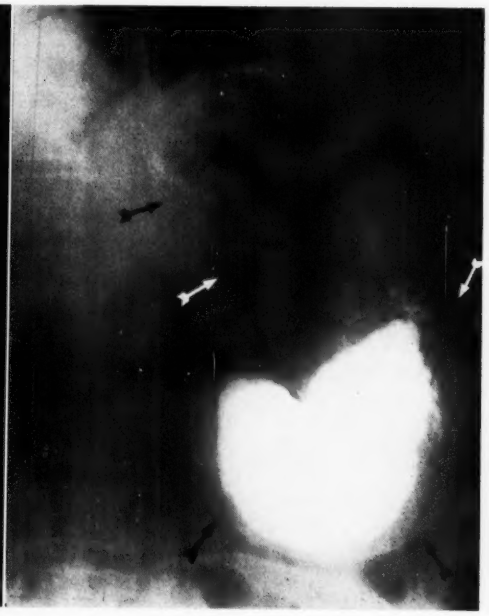

Fig. 4. Roentgenogram of same case of pyloric obstruction made in oblique position, demonstrating a small amount of barium in the lower portion of the stomach. The stomach is outlined by non-opaque fluid, which represents the shadow observed in the preliminary roentgenogram (Fig. 3). (Roentgenogram from Sinai Hospital.)

new roentgen sign of the presence of a pyloric obstruction, as evidenced by the excessive amount of fluid retained in the fasting stomach.

A visible dense stomach shadow may in rare cases be seen in some forms of gastritis, such as phlegmonous gastritis, and in the sclerosing type of carcinoma, such as linitis plastica. These conditions represent a pathologic state of the gastric wall which is not considered in this presentation.

A dense homogeneous stomach shadow seen roentgenologically may resemble a neoplastic mass and necessitates a thorough and careful investigation for differentiation. It may resemble an aortic aneurysm, a kidney neoplasm or cyst, a subdiaphragmatic abscess or diaphragmatic tumor, an enlarged spleen, an adrenal tumor, a cyst of the pancreas, or an enlargement of the left lobe of the liver.

SUMMARY

The visualization of the cardia of the stomach in preliminary roentgen studies is a normal finding, without clinical significance. The demonstration of the contour of the entire stomach as a dense homogeneous shadow is more or less rare. It is due to an excessive amount of fluid in the stomach, and when seen in the fasting state is indicative of pyloric obstruction, with a large gastric retention. A visible shadow of the entire stomach is a new roentgen sign of pyloric obstruction. Roentgenograms illustrating the dense shadows of the cardia and the contour of the entire stomach are reproduced.

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AN OINTMENT FOR THE RELIEF OF DISCOMFORT DUE TO SEVERE IRRADIATION EPIDERMITIS

By HOWARD HICKS ASHBURY, B.S., M.D., *Baltimore, Maryland*

MANY ointments and solutions have been suggested for the relief of the discomfort due to irradiation epidermitis. Kaplan and Rubenfeld reported indifferent success with boric acid, azochloramid, caroid, sea water, bland ointments such as zinc oxide, boric acid, yellow oxide of mercury, radiolatum, joncolia, borofax, vaseline, nupercaine, alvagel, and similar preparations. They recommended aquaphor as the most efficient remedy in combating the burning pain of radiation effects on the skin.

Recently, the author has treated a patient with a carcinoma of the vulva. The patient was unacceptable for surgery and protracted fractional doses of roentgen rays were administered until complete skin and mucous membrane denudation were produced over the involved tissues. This area is a particularly tender one, and the presence of the disease, plus the irritating effect of urine on the lesion, caused severe discomfort. The addition of a severe radiation reaction rendered the condition almost unbearable. In an effort to relieve this patient, an excellent result was obtained by the addition of tetracaine to aquaphor. Complete relief of discomfort, pain, and burning followed the use of this ointment. It was applied locally by the patient, two or three applications in twenty-four hours being sufficient to control the symptoms. Following the subsidence of the radiation effect, gold seeds containing radon were inserted into the residual tumor. Continued application of the ointment relieved the symptoms of the radium reaction, and healing took place without incident. No ill effects from the ointment were noted over a period of four months.

Kaplan described aquaphor as a cholesterolized petrolatum with "an absorption base containing as the active hydrophyllic ingredient, 6 per cent of a group of esters of cholesterols in an aliphatic hydrocarbon base. It appears as a pale yellow, semisolid, odorless unguent that is neutral in reaction and has the property of absorbing 200 per cent water by weight. Aquaphor mixes well with fatty and aqueous excretions of the skin; it spreads easily and melts at body skin temperature."

The physical and chemical properties are unchanged by the addition of tetracaine in therapeutic proportions. Tetracaine is a white crystalline powder which is soluble in water and alcohol. The aqueous solution is neutral. The chemical formula is para-butyl - aminobenzoyl - dimethylamino-ethanol hydrochloride.

CONCLUSION

Tetracaine, 0.5 to 1.0 per cent, in aquaphor proved in the case reported to be an efficient agent in relieving the pain incidental to severe radiation reactions of the skin and mucous membranes of the external genitalia. This ointment should be of value in other sensitive areas of the body, such as the axilla; but for the average radiation skin reaction, aquaphor alone should be sufficient to control discomfort.

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CASE REPORTS AND NEW DEVICES

FRACTURE OF BOTH FEMORAL NECKS AND OF THORACIC VERTEBRAE FOLLOWING A METRAZOL CONVULSION[1]

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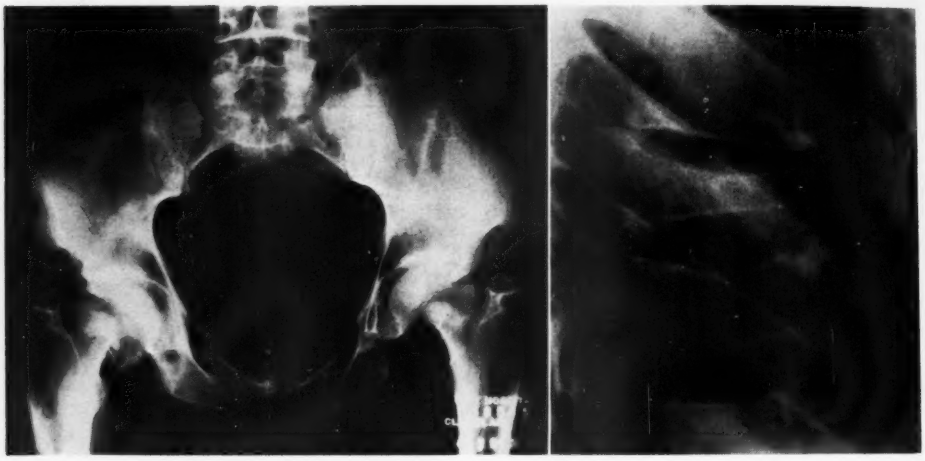
From the Departments of Roentgenology and Neuropsychiatry of Cleveland City Hospital and Western Reserve University

The following cases are submitted to draw further attention to the fact that the long bones, as well as the vertebrae, are susceptible to fracture in the course of convulsive therapy and that, therefore, all patients should be routinely examined following each convulsion to determine whether such an accident has occurred. Only four other instances of bilateral fracture of the femoral neck following convulsive therapy have been found in the literature (Walk and Mayer-Gross; Kerstens, quoted by Walk and Mayer-Gross; Janzen; Somers and Richardson)[2].

Case 1. M. S., a moderately well developed thirty-one-year-old white male, was admitted to the Psychopathic Division of Cleveland City Hospital on April 28, 1938. He had been showing evidence of a mental disorder for two and a half years. He had become suspicious of members of his family and thought that his food and water were being poisoned.

Physical examination revealed no abnormalities. Laboratory findings on blood and urine were negative. The blood and spinal fluid Wassermann reactions were negative, and the spinal fluid showed a one-plus Pandy reaction, no cells, and a colloidal gum mastic curve of 1000000000.

A diagnosis of a paranoid type of schizophrenia was made, and after a considerable period of hospitalization without improvement, metrazol therapy was decided upon. On April 27, 1939, the third in a series of metrazol injections (7 1/2 grains) was administered intravenously, and a typical convulsion lasting forty-five seconds was induced. Following the convulsion the patient complained of pain in both hip joints anteriorly, and held both legs in moderate abduction. There was no pain on passive motion of the lower extremities. Roentgenograms taken two days later revealed fractures of both femoral necks. There was a slight upward displacement of the shaft of the femur on the right, but the position and alignment on the left were satisfactory (Fig. 1). Orthopedic consultation was obtained and a Smith-Petersen nail was inserted on each side.

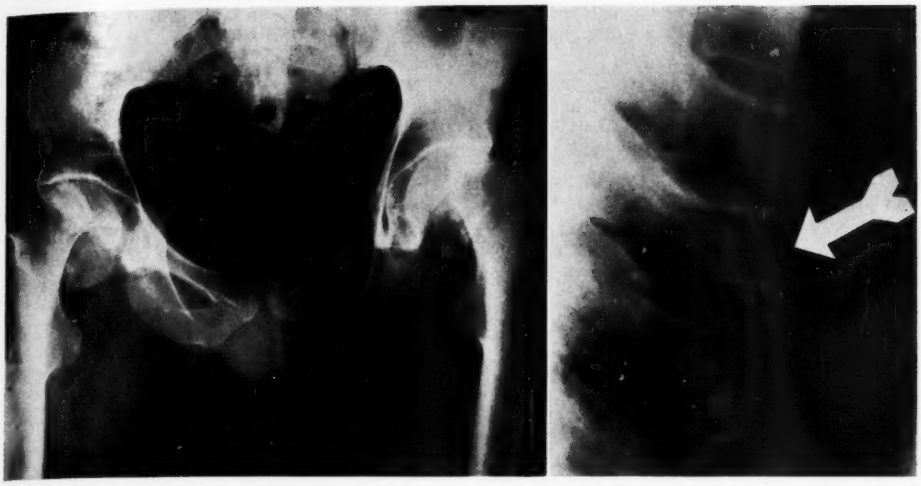


Figs. 1 and 2. Case 1: Anteroposterior view of the pelvis showing fractures of both femoral necks. There is slight upward displacement of the shaft on the right, with some varus deformity. The position on the left is good.

Lateral view of the thoracic spine showing a compression fracture of the seventh thoracic vertebra with a considerable amount of wedging in the anterior portion of the body. The eighth thoracic vertebra shows a fracture in its upper anterior portion, with less wedging.

[1] Accepted for publication in November, 1939.

[2] For references, see Bibliography on pages 729–730 of this issue of RADIOLOGY.



Figs. 3 and 4. Case 2: Anteroposterior view of the pelvis showing fractures in both femoral necks. On each side the fracture is just lateral to the head, and the shafts are externally rotated and displaced upward.
Lateral view of the thoracic spine showing compression fractures of the fourth, fifth, sixth, and seventh thoracic vertebrae. The deformity in each individual vertebra is not great, but the total deformity caused by all the fractures is represented by a slight kyphosis. The arrow is at the level of the sixth thoracic vertebra.

In view of our more recent experience with asymptomatic fractures of the vertebral bodies, roentgenograms of the spine were taken, in spite of the fact that the patient had no back pain. These revealed a compression fracture of the seventh thoracic vertebra, with pronounced anterior wedging, and a similar but less severe fracture of the eighth thoracic vertebra (Fig. 2). No osteoporosis was present. There were no neurological signs of spinal cord damage.

Case 2 (reported by courtesy of Dr. R. E. Bushong.).[3] J. V., a thirty-three-year-old white barber, was admitted to the Cleveland State Hospital on July 24, 1939. He had been previously admitted to the same institution for a brief period in 1932. A ten-year history of introversion and mild dissociation was obtained from his relatives. In recent months his behavior had become worse, and he had refused most of his meals. The admission diagnosis was simple schizophrenia.

The patient was fairly well developed, but poorly nourished. The physical findings were not significant except for emaciation. Laboratory tests, including the Wassermann and Kline reactions, were reported as yielding normal results.

As the patient failed to improve mentally, metrazol therapy was instituted. On Oct. 16, 1939, an initial dose of 6 grains of metrazol was administered intravenously. During the height of the convulsion a loud snap was heard, and after the postconvulsive confusion had cleared, the patient complained of pain in both hips, and of inability to walk. A roentgenogram of the pelvis showed fractures of both femoral necks, intracapsular in site (Fig. 3).

On Nov. 9, after Smith-Petersen nails had been inserted on both sides, lateral roentgenograms of the lumbo-dorsal spine were taken, although the patient did not complain of back pain. These studies revealed compression fractures of the fourth, fifth, sixth, and seventh thoracic vertebrae (Fig. 4). No neurological evidence of spinal cord damage was present.

[3] Superintendent of Cleveland State Hospital.

MULTIPLE MYELOMA

REPORT OF AN UNUSUAL CASE[1]

By JANUARIUS A. PERILLO, M.D., *Buffalo, N. Y.*

From the Radiologic Department of the Edward J. Meyer Memorial Hospital

A white male, twenty-five years old, was admitted to the Edward J. Meyer Memorial Hospital in November, 1938. He had had no complaints until 1936, when he began to experience aching in the anterior aspects of both thighs after working all day. Relief was sought through chiropractic treatments but none was found. In May of 1938 pain developed in the lumbar region, radiating down the legs. This grew progressively worse and forced the patient to stop work in October. At the time of admission he had intermittent

[1] Accepted for publication in April, 1940.

sharp pains in the back and was unable to walk without support. The past and family history was unimportant.

The patient was well developed, but poorly nourished, appearing moderately ill. There were no palpable deformities or softenings on the skull or ribs. The spine was rigid but not tender. There was spasm of the muscles about the right hip. The reflexes were normal. The blood pressure was 180/114.

The urine was normal. Repeated attempts failed to reveal Bence-Jones protein. The Wassermann reaction was negative. The blood showed a severe secondary anemia. The blood calcium on successive occasions was 12.41, 13.17, 13.0, and 6.2 ionized (calculated from the total calcium as determined by the method of Clark and Collip). The phosphorus was 4.9, 5.1, and 4.3. The phosphatase was 3.2 Bodansky units; plasma chlorides 630; albumin 2.82 gm. per cent; globulin 3.73 gm. per cent; total protein 6.55 gm. per cent; the A/G ratio 0.72.

A biopsy was made from a lesion in a rib. The section showed profuse proliferation of cells with occasional mitotic figures. These cells were about the size of a large lymphocyte. Some cells showed reticulation of the nuclei, but not regularly; others had cytoplasmic processes suggesting a reticulum (Fig. 1). There were many clusters of small lymphocytes scattered around among the larger cells. An occasional eosinophil was noted. None of the normal bone marrow elements was seen. Occasionally there was seen a large cell that was similar to a megakaryocyte. These cells, however, were not well defined, and were few in number. The picture was regarded as in keeping with myeloma.

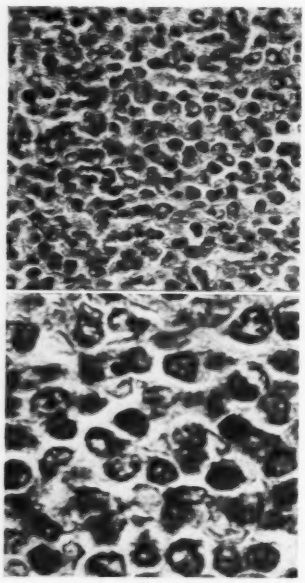


Fig. 1. Multiple myeloma: section obtained by biopsy. Note uniform cell size and the resemblance to lymphocytes in the low-power picture (×600), and in the high-power (×1,000) the reticulation of some of the nuclei, as in plasma cells.

Fig. 2. Multiple myeloma: roentgenogram of lumbar spine. Note diffuse rarefied appearance of all bodies of the vertebrae.

Roentgen examination revealed a widespread involvement of all the bones of the body (Figs. 2–4) except those distal to the knee and elbow. Numerous sharply circumscribed areas of decreased density were scattered through the bone marrow. In the spine and pelvis the tumors were so diffuse as to give the roentgenogram a rarefied osteoporotic appearance. There was no evidence of bone production.

The patient's general condition has remained fairly good over a period of fifteen months, in spite of gradually increasing weakness and progressive muscle and joint pains. Pathologic fractures of the pelvis and both femurs have occurred. The blood pressure has remained persistently elevated.

Discussion.—Certain interesting and un-

usual features are found in this case which make it a rare type of multiple myeloma. The first feature is the patient's age, twenty-five years. The disease usually occurs in later life. Prior to 1927 only five instances were reported in which the patient was less than thirty-five years old. The youngest patient was twenty-two. Few authentic cases have occurred in childhood.

The chemical findings also are of interest. In approximately two-thirds of the cases Bence-Jones protein can be found in the urine. It was not found in this case in repeated tests over a period of fifteen months.

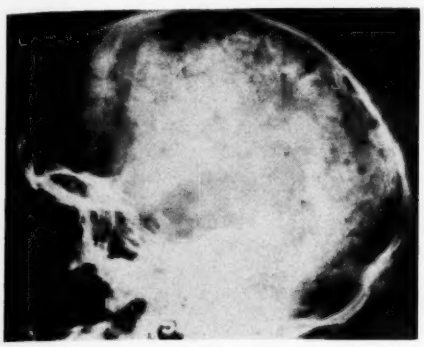


Fig. 3. Multiple myeloma: roentgenogram of skull, showing numerous small punched-out areas throughout. A few lesions are also seen between the inner and outer tables.

Frequently there occurs in this disease a marked increase in the globulin content of the serum. Most often this occurs when Bence-Jones protein is absent. This may aid in making the diagnosis. The increase in the globulin in the case recorded here is slight, being no greater than the non-specific change frequently associated with malignant tumors.

It is probably worth noting that in spite of the relatively normal protein concentration in the serum, and consequently the presence of normal non-ionized calcium content, the total calcium is high. This is in agreement with the views of Gutman and Gutman, who believe that an increase in serum proteins is not regularly the cause of the high calcium concentrations found in multiple myeloma. If permission for a biopsy had not been obtained, these chemical findings might have led to difficulty in arriving at a correct diagnosis. In one respect, however, the chemical analysis did not prove misleading. In most conditions involving intense bone destruction the phosphatase concentration in the serum is high, but in multiple myeloma normal values are usually encountered. In this case the phosphatase concentration in the serum was within normal limits.

Another notable feature in the case is the persistent elevation of both systolic and diastolic blood pressure, with relatively little evidence of cardiorenal changes.

The writer is indebted to Dr. R. S. Hubbard of the University of Buffalo for his invaluable aid in the interpretation of the biochemical findings, and to Dr. C. R. Orr, Roentgenologist-in-Chief at the Edward J. Meyer Memorial Hospital, Buffalo, N. Y., for his helpful suggestions.

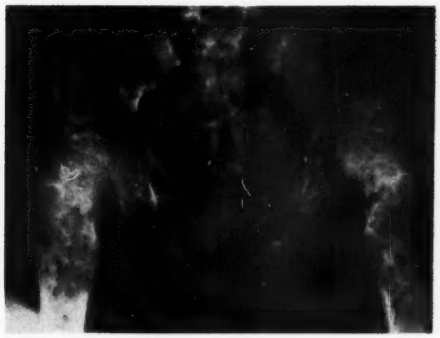


Fig. 4. Multiple myeloma: roentgenogram of pelvis taken four months after admission. Note the progression of the lesions.

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AN AID FOR THE FLUOROSCOPIC ROOM

AN ILLUMINATED WHITE FLUOROSCOPIC TABLE FOOT-PIECE[1]

By T. J. WACHOWSKI, M.D. *Aurora, Ill.*

Department of Roentgenology, Copley Hospital

The average patient who enters a dimly lighted fluoroscopic room for the first time finds himself in strange surroundings. His feeling of uncertainty is usually increased when he is told to "step up" on a vaguely visible fluoroscopic table foot-rest. In my experience at least, this simple act has generally called for a strong guiding hand and mis-steps on the part of the patient are frequent. The thought of a sprained or possibly broken ankle has often disturbed me.

In an attempt to improve the situation, I had an auxiliary light installed, attached to the tube rail-stand, and directed at the foot-piece. A handily placed switch enabled me to turn on a moderately bright red light which illuminated the foot-piece until the patient had mounted it.

Recently, while having an old-style narrow iron foot-piece remodeled by the installation of a twelve inch deep wooden platform, it occurred to me that a white paint job might be the answer to the mis-step problem. The success of the white foot-piece was immediate. When lighted up by the spot light, it is easily visible, and the fact that it is elevated from the floor is readily discernible. Patients show a certainty in mounting this white foot-piece that has been gratifying and re-assuring.

[1] Accepted for publication in November, 1940.

EDITORIAL

HOWARD P. DOUB, M.D., *Editor* JOHN D. CAMP, M.D., *Associate Editor*

THE USE AND ABUSE OF THE TERM HYPERTROPHIC ARTHRITIS RELATIVE TO MARGINAL CHANGES IN THE VERTEBRAE

The term hypertrophic arthritis has been and still is being used relative to the marginal changes found about the bodies of the vertebrae, cervical, dorsal, and lumbar. For these conditions the Germans have always used the term arthritis deformans; the English, osteoarthritis; the accepted American term has for some time been hypertrophic arthritis.

As far as roentgenologists are concerned, the term hypertrophic arthritis should not be used. It has no foundation of fact, it is not accurate, and it has no pathological basis to substantiate its use. The accepted definition of the word arthritis is "inflammation of a true joint," while a true joint is properly defined as one "with a secreting synovial membrane." If, then, these two definitions are accurate, the term hypertrophic arthritis has no place in our nomenclature relative to marginal changes of and about the bodies of the vertebrae.

It may be conceded that the use of the term hypertrophic arthritis in a general way, especially in private practice, will do no great amount of harm, since its value lies perhaps in the fact that it is descriptive of the changes found. When, however, it comes to the industrial or medicolegal use of this term, it may become a cause of unnecessary cost to the defendant corporation or insurance company. If use is made of the word arthritis, which means "inflammation," where there is a history of injury (with or without fracture), and if there is no evidence of fracture, claims will be made based on "aggravation." The term that we have used and the term that we would elect to use, which has fundamental basis in fact, is hypertrophic changes. If, then, a question of aggravation arises, the definite statement can be made that there can be no aggravation of these changes, since what we see is normal, healthy bone.

Subsequent to the introduction of the term hypertrophic change, many investigators have given their attention to the cause of these marginal body changes. It is generally accepted that lipping, spurs, and marginal deposits are brought about by chronologic or anatomic age or both, and are in all probability the result of faulty posture, so-called wear and tear, and possibly, underlying all these, occupational changes.

It is unfortunate that in teaching, most instructors adhere to the old nomenclature, especially the use of the term hypertrophic arthritis. There are, on the other hand, a few teachers who will not permit the term to be used either in the classroom or clinic; there are also many lecturers and surgeons who do not sanction the use of the term.

The only time that the word arthritis should be used relative to the vertebrae is when dealing with the Marie-Strümpell type of arthritis. This is the only form of true arthritis that involves the vertebrae. This disease primarily attacks the articular processes. The articular process is the only part of the vertebrae that has a secreting synovial membrane. Later on, advanced changes may involve the ligaments and eventually, as the disease progresses, produce calcification of all the intervertebral cartilages. When changes occur in the articular process, whether they appear on the bodies of the vertebrae or not, the term arthritis confined to the articular processes is acceptable.

In recent years there have been rather definite studies made of the Marie-Strümpell type of arthritis, but the writers have little to say as to the etiological factors. From many years' experience with a relatively large series of cases of Marie-Strümpell's disease in varying stages, unfortunately not tabulated as to rate of onset, type, or age, it has been found that practically all the patients have at some time been exposed to heat, cold, or dampness. One has only to go back to the days of open cars,

trucks, and trolleys in which there was insufficient protection to the operator, to find many cases recorded which, without exception, give a history of some form of exposure. Today, in the Marine hospitals there are records of those in whom these changes occur and it has been noted that many of these patients have followed the sea. The Marie-Strümpell type of arthritis is in large part the direct result of exposure to cold, heat, or dampness. It is one of the serious industrial hazards today, among those who work in low temperature refrigeration and in other occupations at low temperatures, that is, from ten degrees above zero to ten degrees below. These workmen will almost certainly, after a constant occupation period of five years or more, sustain later in life some degree of arthritis of the articular processes.

The Marie-Strümpell type of arthritis is the only true form of arthritis of the vertebrae. While all the etiological factors may not be known, we do know that a large percentage of these cases are attributable to the causes here presented.

One interesting corollary to this study is the extreme infrequency of vertebral infections of an osteomyelitic nature. If we accept osteomyelitis in its various forms as the most common destructive bone lesion coming under the infectious classification, it is rather a mystery why the vertebrae are not as subject to it as are the long bones or other portions of the skeleton. It is interesting to note that in a case of true osteomyelitis of the vertebrae, two main diagnostic features are found. The first is the rapidity of the change in the body of the vertebra and its adjacent parts, such as the vertebral processes, the reaction occurring in a very short period of time, weeks rather than months. This reaction is out of all proportion to the development of marginal changes or spur formations, whether they be the result of fracture or not. The second is a purely clinical manifestation, extreme pain and disability with consequent blood and temperature changes.

The term hypertrophic arthritis must beyond any reasonable doubt be discarded as used relative to changes in the vertebrae, except those changes which occur in and about the articular processes. The term hypertrophic changes can be accepted without reservation, since the word hypertrophic means increase in the amount of normal bone. It is believed that the use of this word will not arouse controversy in any sense. It is hoped that roentgenologists will dispense with the term hypertrophic arthritis and substitute for it the term hypertrophic changes.

ARIAL W. GEORGE, M.D.

ANNOUNCEMENTS

At the recent meeting of the South Carolina Medical Association, Dr. Thomas A. Pitts of Columbia, Radiologist at Providence Hospital, Director of Laboratories at the South Carolina Baptist Hospital, and Consultant Radiologist of the S. C. State Hospital, was elected President of the Association and representative of his state in the House of Delegates of the American Medical Association. Congratulations are extended to Dr. Pitts and to the South Carolina Medical Association, which has thus honored a member of the Radiological Society of North America.

MIDSUMMER RADIOLOGICAL CONFERENCE

The 7th Annual Midsummer Radiological Conference in the Rocky Mountains will meet in Denver, Col., at the Hotel Shirley-Savoy July 31 to Aug. 2. The guest speakers will be Dr. Ross Golden, New York City; Dr. D. S. Beilin, Chicago; Dr. John D. Camp, Rochester; Dr. Leon J. Menville, New Orleans; Dr. John T. Murphy, Toledo; Dr. U. V. Portmann, Cleveland; Dr. Wendell G. Scott, St. Louis.

IN MEMORIAM

ROY A. PAYNE, M.D.

Dr. Roy A. Payne of Portland, Oregon, died on Feb. 12, 1941, at the age of fifty-five. Dr. Payne was born in Pleasant Valley, Mo. He received his medical training at the University of Minnesota, and had practised in Portland since 1916. He was Clinical Associate in Internal Medicine at the University of Oregon Medical School, a member of the Oregon State Board of Health, and a past Counselor for the Radiological Society of North America. In 1940 he was President of the Multnomah County Medical Society.

D. PETER WIENS, M.D.

Dr. D. Peter Wiens, of Peoria, Ill., died at the age of seventy-three, on Jan. 4, 1941. Dr. Wiens was graduated from the Kansas City Homeopathic Medical College in 1892, and had been engaged in the practice of radiology since 1912. He was a member of the Radiological Society of North America.

EDWARD H. WEIS, M.D.

Notice has been received of the death, in January, 1941, of Dr. Edward H. Weis of Chicago, at the age of forty-three. Dr. Weis was a graduate of the University of Illinois, 1935. He was a resident member of the Chicago Roentgen Society and a member of the Radiological Society of North America.

BOOKS RECEIVED

RÖNTGENDIAGNOSTIK DER KNOCHEN- UND GELENKKRANKHEITEN (Roentgen Diagnosis of Bone and Joint Diseases). Vol. I, No. 7. RECKLINGHAUSENSCHE KNOCHENKRANKHEIT (v. Recklinghausen's Bone Disease). By PROF. DR. ROBERT KIENBÖCK, Vienna. A volume paged 541 to 778 with title, preface, and table of contents of Volume I, and with 204 illustrations. Published by Urban & Schwarzenberg, Berlin and Vienna, 1941. Price: 23.00 R.M.(25 per cent discount to foreign purchasers).

DIE DIFFERENTIALDIAGNOSE DER WIRBELSÄULENTUBERKULOSE (The Differential Diagnosis of Vertebral Tuberculosis). By PRIV. DOZ. DR. J. E. W. BROCHER. A volume of 88 pages with 129 illustrations. Published by Georg Thieme, Leipzig, 1941. Price: 14.60 R.M. bound.

ROENTGEN INTERPRETATION. By GEORGE W. HOLMES, M.D., Roentgenologist to the Massachusetts General Hospital and Clinical Professor of Roentgenology, Harvard Medical School, and HOWARD E. RUGGLES, M.D., Late Roentgenologist to the University of California Hospital and Clinical Professor of Roentgenology, University of California Medical School. Sixth Edition, thoroughly revised. A volume of 364 pages illustrated with 246 engravings. Published by Lea & Febiger, Philadelphia, 1941. Price: $5.00.

BOOK REVIEWS

THE CHRISTIE HOSPITAL AND HOLT RADIUM INSTITUTE, MANCHESTER, ENGLAND: FIVE YEAR STATISTICAL REPORT FROM THE INSTITUTE ON THE RESULTS OF RADIUM THERAPY FOR THE YEARS 1932 AND 1933, COMPILED 1939. Contains 100 pages. Published by Rowland Berry & Co., Ltd., Stockport, England, 1939.

This report, compiled by Doctor Ralston Paterson of the Holt Radium Institute, gives a complete record of the results of radiotherapy at that Institute at the end of five years. The work deals almost exclusively with radium

treatment, except as this was supplemented by x-ray irradiation in cancer of the cervix and especially in cancer of the pharynx and larynx.

Radium therapy has made considerable progress in England in the past few years, and the results have been most encouraging in many accessible types of malignancy. The Radium Commission in England now requires that every national center shall follow up all patients treated. The Holt Radium Institute has traced the 1932 and 1933 cases so successfully that only 2 per cent of those treated were unaccounted for.

The report is divided into two sections. The first is a general survey containing statistical information regarding five-year cures in all cases treated, classified according to the part of the body affected. Section 2 is more technical, furnishing a detailed analysis of the results obtained with different methods. The changes in procedure are dealt with rather generally, but adequate references are given at the end of the report to publications by members of the staff, so that the exact radium technic can be determined. The results of therapy have been definitely encouraging. For instance, during 1933 1,047 patients with malignant disease of various organs were treated. The five-year cure rate of early cases only, which constituted a third of the total, was 80 per cent. The five-year cure rate of the early and moderately early cases, which constituted over half the total cases, was 63 per cent, and of the advanced cases, which constituted less than half the total, 18 per cent. The five-year rate for all cases was 43 per cent. This is 5 per cent better than that achieved the preceding year, 1932.

This report is most interesting and in these days of agitation for cancer control deserves wide distribution among those interested in the therapy of malignant disease and related problems.

MALIGNANT DISEASE AND ITS TREATMENT BY RADIUM. By STANFORD CADE, F.R.C.S. Surgeon, Westminster Hospital and The Radium Institute; Lecturer in Surgery, Westminster Hospital Medical School; Associate Examiner in Surgery, University of London; late Hunterian Professor and Arris and Gale Lecturer, Royal College of Surgeons of England; Member of the Grand Council, British Empire Cancer Campaign. A volume of 1259 pages with 623 illustrations, many in color. Published by The Williams and Wilkins Co., Baltimore, 1940. Price: $18.00.

This volume is a complete treatise on radium and its relation to the treatment of malignant neoplasms. The subject matter is divided into three parts: (1) The Radio-Activity of Radium (Physics); (2) The Biological Effects of Radiation; (3) Malignant Disease: Its Natural History and Treatment.

In part one the physics of radium is discussed in a manner which is practical rather than ultra-scientific. The various forms of applicators are described together with the methods employed in their use. Dosimetry is discussed and a warning is issued against the dangers of excessive dosage to radium workers by stray and direct radiation.

Part two takes up the question of radiosensitivity and the mode of action of radiation. The effects on normal tissues and organs are discussed in a manner which is both readable and instructive but not in such detail as to be all-inclusive. A chapter is devoted to the effects of radium on malignant tumors of different histologic types. A chapter is also included on the dangers associated with radiotherapy.

The third and principal part of the work, comprising almost 1000 pages, is devoted to clinical studies. The subject is discussed according to anatomical sites of disease, as the tongue, breast, skin, etc. In each chapter the natural history of the malignant lesion is considered from a clinical standpoint, the choice of the method of treatment is discussed, and finally the technic of radium treatment is outlined.

The clinical descriptions are lucid and comprehensive. The unbiased discussion of the factors affecting the choice of treatment is extremely valuable, as it considers the subject from the standpoints of the primary lesion, node involvement, and recurrence. The various methods employed in radiotherapy are clearly described and illustrated.

An adequate index permits ready reference to the text, and each chapter is followed by a bibliography pertaining to the subject matter under discussion. This volume will fill a treasured niche in the library of many radiotherapists and others interested in the study of malignant disease.

RADIOLOGICAL SOCIETIES IN NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying information to keep these notices accurate and up to date? Please send information to Howard P. Doub, M.D., Henry Ford Hospital, Detroit, Mich.

UNITED STATES

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Wilbur Bailey, M.D., 2007 Wilshire Blvd., Los Angeles.

Los Angeles County Medical Association, Radiological Section.—Secretary, Wilbur Bailey, M.D., 2007 Wilshire Blvd.; Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, J. Maurice Robinson, M.D., University of California Hospital. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (University of California Medical School) and for the second six months at Lane Hall (Stanford University School of Medicine).

COLORADO

Denver Radiological Club.—Secretary, Paul R. Weeks, M.D., 520 Republic Bldg. Meets third Friday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Elliott M. Hendricks, M.D., 314 Sweet Bldg., Fort Lauderdale. The next meeting will be at the time of the annual meeting of the Medical Association of Florida in the spring.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, Robert C. Pendergrass, M.D., Prather Clinic Bldg., Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—Secretary, Chester J. Challenger, M.D., 3117 Logan Blvd. The Society meets at the Palmer House on the second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Earl E. Barth, M.D., 303 E. Chicago Ave., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Joseph C. Bell, M.D., 402 Heyburn Bldg., Louisville. Meeting annually in Louisville, third Sunday afternoon in April.

LOUISIANA

Shreveport Radiological Club.—Secretary-Treasurer, W. R. Harwell, M.D. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, J. E. Lofstrom, M.D., 1536 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

The Kansas City Radiological Society.—Secretary, P. E. Hiebert, M.D., 907 North Seventh St. (Huron Bldg.), Kansas City, Kansas. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Wilbur K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, D. A. Dowell, M.D., 816 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society.—(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, W. James Marquis, M.D., 198 Clinton Ave., Newark. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, L. J. Taormina, M.D., 1093 Gates Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Eric J. Ryan, M.D., St. Luke's Hospital, New York City.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, H. A. Mahrer, M.D., 10515 Carnegie Ave., Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Justin E. McCarthy, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport; The Society meets annually; time and place of next meeting will be announced later.

The Philadelphia Roentgen Ray Society.—Secretary, Barton R. Young, M.D., Temple University Hospital, Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Harold W. Jacox, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Malcolm Mosteller, M.D., Columbia Hospital, Columbia. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, L. W. Baird, M.D., Scott and White Hospital, Temple. Meets annually.

VIRGINIA

Virginia Radiological Society.—Secretary, Charles H. Peterson, M.D., 603 Medical Arts Bldg., Roanoke.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee, Roentgen Ray Society.—Secretary-Treasurer, Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Section on Radiology, Canadian Medical Association.—Secretary, W. J. Cryderman, M.D., Medical Arts Bldg., Toronto.

Section on Radiology, Ontario Medical Association.—Secretary, W. J. Cryderman, M.D., 474 Glenlake Avenue, Toronto.

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. C. Singleton, M.D., Toronto.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

ABSTRACTS OF CURRENT LITERATURE

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ROENTGEN DIAGNOSIS

THE HEAD

Roentgenologic Investigations on the Intracranial Subdural Space with a View to Revealing the Presence of Subdural Adhesions. H. Hemmingson. Acta Radiol. **21:** 379–391, August, 1940.

The author presents clinical histories and roentgenograms of several patients with post-traumatic encephalopathy and epilepsy. In most of the cases subdural adhesions were demonstrable by means of encephalography. In several instances the x-ray diagnosis was confirmed by a subsequent Penfield operation.

ERNST A. SCHMIDT, M.D.

THE CHEST

Recent Progress in the Bronchographic Examination of Bronchogenic Carcinoma. P. L. Farinas. Am. J. Roentgenol. **44:** 370–383, September, 1940.

A few modifications in the technic of serial bronchography are introduced: 0.5 per cent pantocaine in the least possible amount is used for anesthesia; the patient is thoroughly instructed about the examination; uroselectan is used as the opaque medium.

A classification of bronchogenic carcinoma is presented.

(1) *Polypoid types* occur in the primary or secondary bronchi, and present a characteristic filling defect in the bronchial lumen, with frayed borders which permit differentiation from benign polyps. Below the filling defect, the bronchus is always dilated.

(2) The *infiltrating forms* are of several types: (*a*) those situated in the large and lobar bronchi, where the early lesion produces a concentric narrowing of the lumen with irregular borders, and the more advanced lesion, with complete occlusion, shows an opaque cone which, before 1933, was the only bronchographic sign of bronchial cancer; (*b*) those situated in bronchi of the third or fourth order, where complete obstruction predominates, though concentric narrowing is sometimes observed; (*c*) those situated in bronchi of very small caliber, where the bronchographic image is always that of complete obstruction.

(3) In the *mixed forms*, which never occur in bronchi smaller than those of fourth order, a polypoid tumor is observed, with infiltration of the bronchus distal to it.

With regard to the character of extension of the tumor from the bronchus to the lung, the types may be classified as: (1) infiltrating, when the roentgenographic shadows are located in the region of the hilum if the lesion begins in the larger bronchi, or in the region of the pulmonary field if the primary growth is in a small bronchus; (2) nodular, either apical or lobar, giving rise to a dense round shadow with sharp borders.

The infiltrating forms respond better to deep roentgen therapy, and the nodular types are more appropriate for surgery.

S. M. ATKINS, M.D.

Tuberculosilicosis. L. Benson. New England J. Med. **223:** 398–407, Sept. 12, 1940.

This is a review of 207 granite workers with silicotuberculosis, which is defined as the condition in the lungs caused by the combined action of tubercle bacilli and silica dust. The presence of silicosis enhances the destructive action of tubercle bacilli. The local reaction in silicosis is quite similar to that produced in tuberculosis.

The differential diagnosis between silicosis and tuberculosilicosis is one of degree. There are no standards for a definite opinion in borderline cases. In tuberculosilicosis the nodules lose their sharp, clear-cut borders and acquire ill-defined radiating borders. The diagnosis of tuberculosilicosis requires that the existence of a silicosis hazard shall have been proved.

With the onset of tuberculosis in silicosis, there is dyspnea, usually out of proportion to the apparent involvement, cough, expectoration, chest pain, and hemoptysis. Later signs of toxemia occur.

Roentgenographically, it is difficult to differentiate early uncomplicated silicosis and tuberculosis, with a single film. In uncomplicated silicosis the hilar shadows often recede, even though the lung fields show more intense nodulation. Tuberculous infection is often noted in those cases in which the hilar shadows enlarge and become sharply defined. Conglomerate nodular areas become fluffy and ill-defined when tuberculosis supervenes.

There are several clinical forms of tuberculosilicosis. The primary complex is seldom influenced by the inhalation of silica. The commonest type in granite workers is that in which the silicosis seems to be superimposed on an old reactivated tuberculosis. A less frequent type is that with a rapid course and early cavity formation, resembling bronchopneumonia in onset. In the least frequent type there is a very acute onset of symptoms with early films showing fuzzy borders about the nodules, which increase in size in a few months.

JOHN MCANENY, M.D.

Abnormally Wide Respiratory Movement of Lower Lung Structures; Roentgen Evidence of Obstructive Emphysema. R. Golden. Am. J. Roentgenol. **44:** 325–332, September, 1940.

The usual roentgen signs of obstructive emphysema are: (1) increased transparency of the affected lung; (2) depression and limitation of movement of diaphragm on the affected side; (3) displacement of heart and mediastinal structures away from the affected side; (4) increased excursion of the diaphragm on the unaffected side.

In some instances of inferior or middle lobe obstruction, several or all of these signs may be lacking. Attention is called to a previously unmentioned sign, namely, the abnormal displacement of shadows in the affected part of the lower lung, to a degree parallel with and approximately equal to the diaphragmatic

excursion. This displacement is far less marked in a normally compressible lung.

Landmarks which may aid in the detection of abnormal respiratory movements of a portion of the lung are areas of calcification, bronchial markings, and interlobar fissures.

S. M. ATKINS, M.D.

Bronchiectasis after Bronchial Occlusion Caused by a Tuberculous Hilus Gland. E. Huizinga. Acta Radiol. **21:** 392–398, August, 1940.

The development of ampullar bronchiectasis following occlusion of the bronchus of the right lower lobe is described in detail. The patient was a ten-year-old boy when the obstruction, apparently due to the perforation of a tuberculous hilus gland, occurred. Atelectasis of the right lower lobe ensued. Six years later, the atelectatic lung showed reventilation but bronchiectatic changes. Stenosis of the bronchus persisted. The clinical symptoms were insignificant.

ERNST A. SCHMIDT, M.D.

Basal Exudates of Subphrenic Origin. L. R. Sante. Am. J. Roentgenol. **44:** 350–356, September, 1940.

In the differential diagnosis of basal lesions of the pleural cavity, all the well known clinical signs and ordinary roentgen procedures should be utilized before resorting to extraordinary diagnostic maneuvers. Among ordinary measures are roentgenography in the upright, recumbent, and lateral decubitus positions, the barium meal and enema for the detection of subphrenic involvement of gastro-intestinal origin, and roentgenoscopic observation of movements of the diaphragm. A fixed diaphragm merely indicates an inflammatory process above or below that structure, involving either the parietal pleura or parietal peritoneum. In subdiaphragmatic infection, pleural effusion may occur above the diaphragm, without actual extension of infection.

In determining the origin of basal exudates, the most important factor is the location of the diaphragm with relation to the pathological process. Artificial pneumoperitoneum is the best aid to roentgen exploration of the subphrenic space. When a Potain aspirator pump is used and only small amounts of air are introduced, the writer has never seen any unusual consequences. After inflation the patient is rolled upon his side or is supported in an erect position; the part to be examined is kept uppermost. In the presence of an inflammatory process, the subdiaphragmatic space is obliterated or adhesions to the underlying structures are evident.

Causes of subdiaphragmatic abscess are: perforating lesions of the gastro-intestinal tract, abdominal operative procedures, perinephric abscess.

S. M. ATKINS, M.D.

Acute Mediastinitis. H. Neuhof and C. B. Rabin. Am. J. Roentgenol. **44:** 684–703, November, 1940.

Acute mediastinitis can be classified according to its pathology, etiology, or clinical signs. In view of the inconstancy of physical signs, roentgenography is of utmost diagnostic importance, since the principal operative measure is prophylactic, namely, appropriate treatment of the esophageal lesion which frequently precedes the mediastinal infection. Once infection has developed, adequate drainage after roentgen localization is the proper procedure.

In mediastinal lymphadenitis, no roentgen signs are seen unless the nodes are enlarged. The phlegmonous type may show no widening or other evidence of pathology, or only a bilateral pleuritis. In most cases there is an early diffuse widening of the superior mediastinum that cannot be differentiated from an empyema of the mesial portion of the pleural cavity. The contours become straight, sharply demarcated, and vertical. The uppermost portions spread outward over the apex of the lung. In the lower mediastinum a diffuse inflammation is difficult to recognize.

Films should be taken in complete inspiration to avoid expiratory widening and a lateral view of the neck should be included since most cases of mediastinitis follow neck conditions.

S. M. ATKINS, M.D.

Rapid Tomographic Study of the Heart and Great Vessels, A. C. Morelli. Rev. argent. de cardiol. **7:** 217–229, September-October, 1940.

Morelli believes that tomography has not attained the expected generalized use because of the fuzziness and lack of detail in the radiographic image. To overcome this objection he used the following extra-rapid technic, by the aid of which he has been able to produce clear images of the heart and great vessels at desired levels.

With the aid of two springs equivalent in strength—one to accelerate and the other to retard speed—a rapid rotatory motion is given to the tomograph with the least disturbance to the patient. The force is so graduated as to impel a progressively accelerated movement during the first half of the run and symetrically retard it during the second half, the exposure being made during the end of the first and beginning of the second run. By this arrangement a greater velocity is attained at the center of the angle in which the radiograph is obtained.

The exposure factors recommended are: time 0.03 to 0.1 sec., 150 ma., 120 kv., on a 10° angle.

A. MAYORAL

Dysphagia with Disorders of the Heart and Great Vessels. A. L. Bloomfield. Am. J. M. Sc. **200:** 289–299, September, 1940.

To understand the occurrence of dysphagia in diseases of the heart and aorta, it is necessary only to recall the intimate relationship of the esophagus to the aortic arch and thoracic aorta, and to the heart, particularly to the left auricle.

While compression of the esophagus by an enlarged left auricle occurs frequently, clinical dysphagia from this cause is excessively rare. A case is reported in

which the dysphagia was probably due to spasm secondary to pressure from an enlarged left auricle rather than to obstruction. Occurring in the presence of pericarditis, dysphagia may indicate the presence of a very large amount of pericardial fluid. Sacular aortic aneurysm less often causes dysphagia than compression of the air passages. Mild dysphagia, due to reflex spasm, is frequently seen in this condition. Severe persistent dysphagia seems to indicate the presence of a false aneurysm, or to threaten rupture into the esophagus.

Dysphagia occurs frequently with vascular anomalies such as right aortic arch, double aortic arch, and aberrant right subclavian artery; it is due to compression of the esophagus from behind.

Pressure on the esophagus from a dissecting aortic aneurysm must occur frequently. That clinical dysphagia is not complained of is probably due to the predominance of the other more desperate symptoms.

BENJAMIN COPLEMAN, M.D.

Reversible Dilatation of the Pulmonary Arch in Hyperthyroidism. E. B. del Castillo, J. Reforzo Membrives, and F. A. de la Balze. Rev. argent. de cardiol. **7:** 158–163, July–August, 1940.

The writers report the case of a seventeen-year-old girl with thyrotoxicosis, whose heart on x-ray examination of the chest showed a marked prominence of the pulmonary arch. This prominence gradually disappeared after thyroidectomy. This is considered presumptive evidence in favor of the opinion of Cossio, del Castillo, and Fustinoni, that the prominence of the pulmonary arch frequently seen in hyperthyroidism is due to cardiac hyperactivity and not to body habitus, as believed by Gotta.

A. MAYORAL, M.D.

Dissecting Aneurysm of the Aorta with Experimental Atherosclerosis. S. Weiss, T. D. Kinney, and M. M. Maher. Am. J. M. Sc. **200:** 192–203, August, 1940.

In approximately 10 per cent of the reported cases, dissecting aortic aneurysm heals, is not the cause of death, and is compatible with adequate functional capacity for years.

The three cases herein reported are unusual, not only because the dissecting aneurysm was completely healed but also because atherosclerosis was present in the new channel of the dissecting aneurysm.

In a seventy-three-year-old female, the x-ray film showed a double shadow corresponding to the calcified walls of the double aorta. At necropsy, the surface of the new aortic channel was found to be covered with numerous atherosclerotic plaques and endothelial islands. The history offered no clue as to the duration of the dissecting aneurysm.

In a seventy-four-year-old male the history placed the occurrence of the dissection fourteen months before the final admission. The x-ray examination showed the left ventricle to be enlarged. There was considerable widening of the aortic arch with calcification of the wall. The central portion of the aortic shadow was darker than the peripheral shadow. The new channel was covered with endothelium; atheromatous changes were present.

In the third case the patient was admitted in coma, from which he did not recover. At autopsy, changes in the aorta similar to those found in the two previous cases were noted in the new aortic channel.

The etiology was atherosclerosis in Case 1, and arterial hypertension in Cases 2 and 3. Although syphilis was present in Case 3, it played no rôle in the formation of the aneurysm.

In each case the dissecting aneurysm was probably of long duration, and the factors which led to atherosclerosis in the original aorta caused similar changes in the wall of the dissecting aneurysm.

BENJAMIN COPLEMAN, M.D.

DIGESTIVE TRACT

Intestinal Obstruction in the Newborn Due to Congenital Anomalies. D. M. Glover and C. A. Hamann. Ohio State M.J. **36:** 833–840, August, 1940.

In an excellent article the authors present 18 examples of obstruction due to congenital anomalies, collected from the records of three large Cleveland hospitals over a seventeen-year period. This series does not include 21 cases of anal or rectal obstruction due to anomalous formations. The preliminary discussion of the embryology of the gastro-intestinal tract describes the formation of the various gut loops, each with its own blood supply.

The most important factor in development is the proper counter-clockwise rotation of the mid-gut loop (supplied by the superior mesenteric artery). Rotation may be partially or totally incomplete, or even reversed. Umbilical hernia is often associated with incomplete rotation, as the mid-gut loop does not completely retract into the abdomen. Even with complete rotation, mesenteric fusion if incomplete may leave bands, defects of abnormally long mesenteric attachments. These may give rise to obstruction or volvulus, even in later life.

Atresia or stenosis is the second main factor. It is believed that after the fifth week, the epithelium of the gut tube proliferates until the lumen is occluded; recanalization then takes place until at birth the lumen is restored. Incomplete recanalization results in stenosis or atresia. A rare type of stenosis was seen in one case where "ring pancreas" developed, encircling and obstructing the duodenum.

The high mortality in this series was due to inability to diagnose the anomaly early. In all cases of persistent vomiting after birth or in early infancy an x-ray study should be done, both plain and with opaque material. The presence or absence of bile in the vomitus is a helpful diagnostic point in localizing the obstruction. Surgery is the only treatment and patients should be prepared with fluids and electrolytes pre-operatively. Anastomoses are indicated, as almost every case in which enterostomy was done in this series ended fatally. Local anesthesia is preferred.

SIMON POLLACK, M.D

Stricture of the Rectum in Lymphopathia Venerea and Its Roentgenologic Aspects. R. Steinert. Acta Radiol. **21:** 368–378, August, 1940.

Steinert describes seven examples of stricture of the rectum due to lymphopathia venerea (lymphogranuloma inguinale). Five of the patients were women, two men. In every instance the Frei reaction was positive. A characteristic roentgen phenomenon in six cases was the abnormal distance between rectum and os sacrum.

ERNST A. SCHMIDT, M.D.

Radiologic Gastro-intestinal Studies in Eczema. A. Strickler and N. O'Farrell. Pennsylvania M.J. **43:** 1703–1708, September, 1940.

Gastro-intestinal studies were done on 33 patients suffering from eczema, a number of films being taken at intervals after the ingestion of barium; no fluoroscopy was done. Intestinal retention is said to have occurred in 44 per cent of the cases.

JOSEPH T. DANZER, M.D.

Congenital Absence of Gallbladder. E. Mauro. Ann. paulist. de med. e cir. **40:** 85–90, August, 1940.

Congenital absence of the gallbladder is an extremely rare abnormality, associated frequently with hepatic calculi. A case is recorded in a thirty-seven-year-old woman, with a stone in the biliary duct. The writer warns that congenital absence and ectopia of the gallbladder should not be confused.

A. MAYORAL, M.D.

GENITO-URINARY TRACT

Renal Factor in Continued Arterial Hypertension Not Due to Glomerulonephritis, as Revealed by Intravenous Pyelography. R. S. Palmer, R. Chute, N. L. Crone, and B. Castleman. New England J. Med. **223:** 165–171, Aug. 1, 1940.

The work of Goldblatt and his associates has stimulated study of hypertension. The literature on the subject is extensive and much of it is reviewed in this paper.

This present study is concerned with the relation between hypertension and abnormalities in the kidneys as demonstrated by pyelograms. The patients studied were all under fifty years of age and numbered 212 (124 women and 88 men).

In this group of patients, 47 (22 per cent) showed abnormalities in the pyelograms, which are listed as hydronephrosis 33 cases, pyonephrosis 16 cases, stone 14 cases, atrophic or fetal kidney 13 cases, hydronephrosis with possible aberrant vessel 7 cases, possible tuberculosis 2 cases, tumor or cyst 1 case.

It is insisted that one be highly critical of the pyelograms and that the excretion study be checked by the retrograde method where there is doubt.

Nine case histories are presented of patients with hypertension who showed an abnormal pyelogram and had one kidney removed. Only one of this group showed much change in the blood pressure readings, and the pressure in the improved case was still definitely high.

It is concluded from this study that, in order to effect a reduction of hypertension where one kidney is deformed, its removal should be accomplished at an early age and before the hypertension has existed for any length of time, and also that the remaining kidney be sufficient to sustain the patient adequately.

JOHN MCANENY, M.D.

Carbuncle or Solitary Abscess of the Kidney. W. L. Estes, Jr. Pennsylvania M.J. **43:** 1566–1570, August, 1940.

A renal carbuncle is defined as "a local cortical suppuration, multilocular and circumscribed, usually due to a metastatic (hematogenous) infection with Staphylococcus aureus."

Positive x-ray findings are not always present but are of value when coupled with a suggestive history and physicial findings. The most common positive finding is an obliterated calyx or a distorted renal pelvis. In the author's experience, "intravenous or retrograde pyelography seemed equally efficacious."

JOSEPH T. DANZER, M.D.

Perirenal and Perinephritic Infections. C. N. Haines. Pennsylvania M.J. **43:** 1561–1565, August, 1940.

The terminology used in describing infections in and around the kidney is confusing and an attempt is made in this paper to clear this up by using the following classifications: "Abscess, perirenal, arising from within the kidney; abscess, perinephritic, arising from outside the kidney."

In this series of 46 cases only 20 showed positive roentgen and cystoscopic findings. Obliteration of the psoas muscle on the affected side, lateral curvature of the spine, and an indefinite opaque shadow in the kidney region were the most common positive findings, and these were generally seen in advanced cases.

JOSEPH T. DANZER, M.D.

Spontaneous Perforation of the Renal Pelvis by Calculus. A. Renander. Acta Radiol. **21:** 343–348, August, 1940.

Renander describes a case of spontaneous perforation of the renal pelvis due to a renal calculus. The condition was diagnosed by intravenous pyelography and confirmed by operation (nephrectomy).

ERNST A. SCHMIDT, M.D.

Testicular Tumors: Nine Cases, Including Epididymoma and Chorioma. A. W. Adams. Brit. J. Surg. **28:** 119–123, July, 1940.

Testicular tumors occur mainly in the middle third of life, with a slow painless history. They often secrete a male sex hormone, which is found in the urine. After orchidectomy this disappears, and its return points to

metastatic activity. The hormone test is thus a useful guide to prognosis and the effectiveness of operation or radiation.

Of the 9 cases reported one was too far advanced for surgery. The radical operation, consisting of removal of the testicle and spermatic vessels, fascia, and nodes draining lymph from the testicle, was performed in 4 cases. The diagnosis in each instance was seminoma. All of these patients were well from eighteen months to five years after operation and the urine was free from male sex hormone. In three cases only the testicle and adjacent cord were removed. In two no outlying spread was detected clinically, but death occurred about twelve months later with metastases.

One case of seminoma arising in the epididymis is reported. The patient is well twelve months after orchidectomy.

An inoperable case of chorionepithelioma is reported in a man of twenty-nine with a history of pain and swelling of the right testicle of three weeks' duration. Roentgenographic examination of the lungs showed circular opacities varying in size from a marble to a golf ball. Postmortem examination revealed widespread metastases.

The author states that teratomatous tumors form 80 per cent of the benign neoplasms of the testicle, and since they are slow growing, and chorionepithelioma rapid, it seems evident that where the two are conjointly present chorioma must be regarded as a secondary development on a pre-existing teratoma. In every instance of testicular swelling a neoplasm must be suspected, and early radical orchidectomy with subsequent radiotherapy is the indicated treatment.

MAX CLIMAN, M.D.

GYNECOLOGY AND OBSTETRICS

Direct Visualization of the Placenta by Soft-Tissue Roentgenography. A. L. Dippel and W. H. Brown. New England. J. Med. **223:** 316–323, Aug. 29, 1940.

Among the various methods of locating the placental site are palpation, rectal examination, determining the point of uterine souffle, injection of thorotrast, amniography, and injection of lipiodol into the placenta. All these procedures have shortcomings or objectionable features. With the development of soft-tissue roentgenography, another method is available.

The authors have studied 200 pregnant women by soft-tissue roentgenography and have been able to determine the location of the placenta in 90 per cent of the cases. The placenta cannot be located in hydramnios and only occasionally in cases of multiple pregnancy. If the placenta is in the lower uterine segment, its lower margin is rarely determined. One must remember that normally the placenta covers about one-fourth of the uterine wall surface, that it is about 7 cm. thick at its deepest point, and that usually the fetus faces the placenta.

Additional information may be obtained from these studies. Thinned uterine walls with irregularity from scars of previous Cesarean section have been observed. The type of Cesarean section may be determined by the location of the placenta.

The technical factors are 50 ma., 4 sec., 65–85 kv. No special equipment is necessary, and the lateral view is usually the only one needed. The development of the films by sight is stressed, as is also the fact that a certain amount of experience is necessary before good films are obtained. The films should be viewed in light of different intensities, depending on the part of the film being observed.

JOHN MCANENY, M.D.

SKELETAL SYSTEM

Spontaneous Fracture of the Apparently Normal Fibula in Its Lower Third. H. J. Burrows. Brit. J. Surg. **28:** 82–87, July, 1940.

Two cases are reported, one in a woman aged sixty-one, the other in a boy aged seventeen. Both complained of pain and swelling in the lower leg just above the ankle. Neither gave a history of trauma. In the first case a roentgenogram made six weeks after onset of symptoms revealed a slightly oblique irregular fracture. The roentgenogram in the second case, three weeks after onset of symptoms, showed an oblique fracture with callus and very slight displacement of the lower fragment.

The author suggests that these cases may be analogous to March fracture of a metatarsal bone. Both conditions have the same characteristics—onset without violence, minimal displacement, and liberal formation of callus.

MAX CLIMAN, M.D.

Fractures of the Shaft of the Tibia: Method of Reduction. I. S. Smillie, Brit. M.J. **2:** 150–151, Aug. 3, 1940.

The method of reduction of fracture of the tibia described by the author may be of interest to the radiologist for the reason that it places the injured member in a position that makes x-ray examination much simpler than is usually the case.

With the patient in a prone position the leg is flexed and drawn upward with a Steinmann pin through the os calcis. The pin is attached to calipers suspended by an adjustable threaded rod which passes through a cross-beam over the patient's bed. Counter traction is made with a thigh clamp attached to the beam by uprights. The situation is such that one may easily get all around the fracture with fluoroscope or plate. Final fixation is made with an additional pin above the point of fracture and application of a light cast.

Q. B. CORAY, M.D.

March Fracture. Report on a Case Involving Both Feet. R. Drummond. Brit. M.J. **2:** 413–414, Sept. 28, 1940.

The March fracture is a fracture of one or more of the metatarsal bones without apparent etiological background. The case described is typical in that during the first few days of observation neither the pa-

tient nor the doctor was aware that fractures had occurred. As swelling increased the typical x-ray findings appeared on the films. The diagnosis of a March fracture is usually made in the callous stage.

This subject bears reiteration for the reason that it represents one of those situations by which diagnosticians are frequently embarrassed.

Q. B. CORAY, M.D.

Tuberculosis of the Knee Joint in Adults. L. A. Key. Brit. M.J. **2:** 408–411, Sept. 28, 1940.

The author opens his article with a brief note on the etiology of the tuberculous knee. The condition, he writes, is a hematogenous extension secondary to an active tuberculosis elsewhere. Trauma played an important rôle in 15 per cent of the series of 108 cases.

In discussing the pathology, it is pointed out that bone disease is predominant in 96 per cent of the cases and that abscesses in the periosteum and surrounding soft tissues are the result. The symptoms and signs are listed as pain, stiffness, limping, swelling, and limitation of motion. The salient point in roentgen diagnosis is the fact that the destructive changes are always more advanced than is apparent in the film. The differential diagnosis and treatment are discussed and an analysis of results is presented

Q. B. CORAY, M.D.

RADIOTHERAPY

GENERAL

Report on Medical Progress: Radiation Therapy. R. Dresser. New England J. Med. **223:** 250–252, Aug. 15, 1940.

It is noted that during recent years the voltage used in radiation therapy has been constantly increasing, several installations of over one million volts now being in operation. High-voltage cathode rays are being used and seem to produce less skin damage than x-rays. Intracavity irradiation is becoming more widely used and with good results.

Low-voltage high-intensity irradiation of brain tumors exposed at operation has produced some promising results. With continued experience much progress is expected in this field.

The best results obtained in a large series of carcinoma of the cervix (780 cases) were with the combined use of x-rays and radium, especially when the x-ray dosage exceeded 3200 r. Clinical classification and pathological grouping are considered as practically useless. In view of these results, the indications for surgery are becoming greatly restricted.

Much promise for cure of carcinoma of the bladder is offered by x-ray therapy.

Carcinoma of the colon is probably best treated by surgery, irradiation being reserved for inoperable cases or recurrences. Relief of pain, cessation of bleeding, and regression of the growth are usually observed, although these patients do not tolerate irradiation as well as some others.

Super-hard x-rays have many advantages over 200-kilovolt radiation. These consist in increased skin tolerance, greater penetration, relative independence of depth dose and portal size, more uniform distribution, and greater depth dose.

Among the non-malignant conditions in which irradiation is recommended are angiomata, fibrous plaques of the penis, paranasal sinus infection, acute catarrhal otitis media, retropharyngeal swelling in children, lymphogranuloma venereum, polycythemia vera, and sterility.

JOHN MCANENY, M.D.

MALIGNANT NEOPLASMS

Pre-operative Irradiation of the Breast, W. E. Howes and H. Bolker. Am. J. Roentgenol. **44:** 98–107, July, 1940.

Statistics of large surgical clinics clearly indicate the inadequacy of the surgical approach in the treatment of the more advanced cases of carcinoma of the breast. When axillary nodes are involved, the five-year curability drops from about 80 to 20 per cent.

The Brooklyn Cancer Institute is employing intensive pre-operative roentgen therapy, taking pre-irradiation biopsies and post-operative specimens to study the changes produced by irradiation. Their therapeutic technic is as follows: (1) The entire breast is cross-fired with parallel beams, one directed through the breast from its medial margin, the other laterally and from behind. The beam emerges through the opposite side of the breast, avoiding the the lung bed. The portals vary from 8 × 10 to 10 × 15 cm. Each receives 200 r for five to six days a week, the total skin dose being limited to 6,000 r, calculated from the emerging beams. Other factors are: 40–50 cm. skin-target distance, 200 kv., Cu 2 mm. and Al/mm., half-value layer 1.90 mm. of Cu, approximately 20 r per minute.

(2) The supraclavicular area is similarly treated through an anterior and posterior portal, 8 × 10 cm.

(3) Axillary portals, 8 × 10 cm. or 10 × 12 cm., may be used last, as the visible skin reaction in the two previous areas will prevent over- or under-treatment. The two axillary portals seldom receive over 2,800 r (in air) each, because of the moist skin surface.

(4) In a few cases treatment is given to combined supraclavicular and axillary portals, thus saving time, but at the expense of thoroughness.

Treatment requires seven to twelve weeks. After an interval of two to three months, radical mastectomy is performed.

Clinically, most tumors and metastases show reduction in size. In two cases, the mass increased in size. In the presence of infection, treatment is instituted with 50 or 100 r and gradually increased. Post-irradiation pleural pulmonitis occurred in two cases.

Grossly the irradiated tumor is usually smaller and often difficult to recognize. Microscopically, the main response is that of cytolysis, affecting both cytoplasm and nuclei. Mitotic figures are rare. The tumor bed shows increased hyalin fibrous tissue with myxomatous change and calcification. The skin changes are atrophy of the epidermis, homogeneity of connective tissue, and telangiectasia. Non-neoplastic tissue is affected, but to a lesser extent.

Metastatic axillary nodes showed but slight change, but the short interval between irradiation in this region and surgery may explain the lack of reaction.

S. M. ATKINS, M.D.

Irradiation Treatment of Malignant Surface Lesions. S. Moore. Northwest Med. **39:** 278–283, August, 1940.

"My thesis is that given the proper amount (which is unknown) of irradiation throughout the extent of the tumor, successful management of the case can be accomplished," writes Dr. Moore; if this is unattainable, the patient should be so treated that the maximum duration of life and well-being are assured. Complete eradication is the aim. This can be accomplished by surgery, irradiation, or a combination of both. Failures are due to inability to determine the full extent of the growth.

Moore believes that surgery should precede irradiation. The greater success in the treatment of external malignant growths he attributes to the fact that the extent of these lesions can be more accurately determined. He refers to the controversy between those who believe that irradiation effects are due to a quantitative and not to a qualitative factor. The majority of opinion to-day, however, is that the energy absorbed is what produces results.

Previous technics are reviewed, but special attention is given to the "skin-flap method of Blair," which consists in exposing the growth by reflecting the skin and subcutaneous tissue and giving the maximum of irradiation to the exposed tumor. Good results are reported in several cases. The low-voltage technic, without filtration, employed in cases of skin cancer, is used. The author cautions against irradiation of carcinomata about the canthus of the eye, also of the nose, upper and lower lips, and auditory canals. Surgery, he believes, is preferable to irradiation in these locations.

Moore thinks that the Chaoul technic of contact roentgen irradiation will come into wide use, because it delivers the maximum amount of rays where action is desired, restricting the amount received by underlying tissues.

A. MAYORAL, M.D.

Selection of Treatment for Cancer of the Larynx. H. S. Martin. Ann. Otol., Rhinol., and Laryngol. **49:** 728–735, September, 1940.

The treatment of laryngeal cancer by any method is accompanied by definite hazards and is unjustified in the absence of histologic proof. The point of origin of the growth rather than its later extension should determine its anatomic classification. At the Memorial Hospital clinic, extrinsic laryngeal cancer is about three times as frequent as intrinsic cancer of the larynx. Intrinsic cancer is a surgical problem, while extrinsic cancer is usually a radiological problem.

Intrinsic cancer is, for the most part, well differentiated squamous carcinoma, Grades I or II, which usually grows slowly, rarely metastasizes, and is highly radioresistant. Such growths fulfill most of the conditions favorable to surgery, *i.e.*, the disease may be diagnosed early; direct extension is limited for a considerable time by the barrier of the cartilaginous larynx; and the lesion may be removed surgically with a safely wide margin by either a partial or total laryngectomy, depending on the extent of the growth.

Extrinsic laryngeal cancer, on the other hand, is rarely diagnosed early; the growth seldom can be removed with a safely wide margin; and the average cancer in this location is highly radiosensitive. It is in this type of case that Coutard first demonstrated the value of fractionated radiation. It must be recognized, however, that surgery has a definite part even in such radiation therapy. Tracheotomy may be necessary because of the increase in local swelling after irradiation. In some cases gastrostomy may be necessary because of the difficulty in swallowing, and implantation of radon seeds may be required as a supplement to the external irradiation.

The author is of the opinion that future improvement in the control of cancer by our present methods depends mainly upon the combination of surgical and radiation therapy in the same individual.

LESTER W. PAUL, M.D.

Radiation Therapy of Esophageal Cancer. J. Nielsen. Acta Radiol. **21:** 352–367, August, 1940.

Nielsen recommends the following radiation technic for the treatment of esophageal cancer: (1) in the upper third of the esophagus, protracted Coutard therapy (9,000 to 12,000 r during five to seven weeks); (2) in lower intrathoracic tumors, Coutard therapy (12,000 to 16,000 r during six to eight weeks), followed by cautious intra-esophageal application of radium.

ERNST A. SCHMIDT, M.D.

Advances in the Treatment of Cancer of the Corpus Uteri. H. S. Crossen. J. Missouri M.A. **37:** 376–386, September, 1940.

Preoperative irradiation is advised in the treatment of cancer of the corpus uteri in order to lessen the risk of fatal infection after operation and to reduce the chance of implantation metastasis. In order to obtain a proper distribution of the radium within the uterine cavity, the author has devised a wire distributor for holding the radium capsules in place. The method of making the applicator and its use are clearly described and illustrated by photographs and drawings. The apparatus is simple and inexpensive. Roentgenograms of the pelvis after insertion of the distributors and radium capsules show that accurate placement can be ob-

tained. In inoperable cases, the larger dosage required necessitates a more extensive distribution of the radium. This is accomplished either by packing the uterine cavity with small units threaded on a long piece of thin rubber tubing or by packing with detached units. The method of choice will depend largely upon the radium supply at hand.

In addition to the intrauterine irradiation, external deep roentgen therapy should be given.

LESTER W. PAUL, M.D.

NON-MALIGNANT CONDITIONS

Roentgen Therapy for Acute Sinusitis. H. L. Williams and W. C. Popp. Ann. Otol., Rhinol., and Laryngol. **49:** 749–754, September, 1940.

Because of a lack of unanimity in the reports found in the literature concerning the value of roentgen irradiation for acute sinusitis, the authors treated a series of cases by this method, the treatment being administered by a roentgenologist and the clinical aspects being handled by a rhinologist. Fifty-six cases were treated, 31 being classed as severe and 25 as moderately severe. In patients with symptoms of one to five days' duration doses of 50 r were used. When the duration of symptoms was more than five days, doses of 75 to 100 r were given. Treatments were repeated on alternate days, from one to three treatments being given depending upon the clinical response. The technical factors employed were 130 kv., 40 cm. distance, and filtration of 6 mm. of aluminum in adults and 4 mm. of aluminum in children.

Clinically, the most striking effect was the relief of pain and headache. Such relief was noted early in those cases in which a favorable result was obtained. Relief of pain often was accompanied by noticeable increase in the discharge, so that the effect of roentgen therapy on sinusitis may be due to the diminishing engorgement of the nasal mucosa. More good results were obtained when the therapy was instituted early in the course of the disease, and the results seemed to be better in an initial attack of sinusitis than in a recurrence after one or more previous attacks.

This study supports the belief that roentgen therapy, while it cannot be depended upon as the sole therapeutic agent in cases of acute sinusitis, is a useful adjunct, especially for symptomatic relief. This study also suggests that the severity of the symptoms and duration of the disease are inversely proportional to the therapeutic effect obtainable.

LESTER W. PAUL, M.D.

Roentgen Therapy of Progressive Paralysis as Proposed by Bering. F. Voss. Strahlentherapie **67:** 693, 1940.

Since roentgen rays are of benefit in the treatment of inflammatory conditions, Bering proposed their use in patients with progressive paralysis. The technic was as follows: 185 kv., 30 cm. focal skin distance, 0.5 mm. copper, 41 r/min., field 10 × 15 cm. Each of four areas received 440 r. Two fields were treated per day with an interval of two or three days between sittings. Undesirable reactions developed, however, as, for instance, severe headache, and the technic had to be modified. The author now gives 60 to 80 per cent H.E.D. on the first day over the frontal region; on the third day 30–40 per cent over the left side of the skull; on the fifth day 40 per cent over the occipital region and right temporal area, and again, on the seventh day, 40 per cent over the posterior neck. This may be repeated after three or four months. Reactions did not occur with this method and total epilation could be avoided.

ERNST A. POHLE, M.D., PH.D.

Effect of X-radiation on Tonsillar Tissue. C. I. Johnson, R. S. Palmer, and L. A. Vance. Ann. Otol., Rhinol., and Laryngol. **49:** 755–758, September, 1940.

The effect of x-radiation in reducing the size of hypertrophied tonsils was studied by the authors. Twenty-one patients received this form of therapy. The treatment factors employed were 200 kv., 20 ma., 50 cm. target-skin distance, and a filtration of 0.5 mm. copper and 1.0 mm. aluminum. Doses of 200 r were given to each of two portals once a week for three weeks. Observations carried out for periods up to one year showed no change in the appearance or size of the tonsils that might not occur in any group of children or young adults observed for this period of time. It is concluded that x-ray treatment in the dosage employed does not materially reduce or eradicate tonsillar tissue.

LESTER W. PAUL, M.D.

Treatment of Mixed Tumors of the Parotid Gland. D. H. Patey. Brit. J. Surg. **28:** 29–38, July, 1940.

This paper is based on reports from recent literature and the author's own experience. A mixed parotid tumor may exist for many years without causing trouble apart from the deformity associated with a gradual increase in size. There is considerable variation in the rate of growth. Some tumors grow very little over a period of many years while others attain a large size in a short time. The average rate of growth is up to the size of a walnut in ten years and an orange in twenty years.

The question of spontaneous malignant change has not been definitely determined. It is theoretically possible for a mixed tumor to change its histologic type and become converted into a squamous-cell or glandular carcinoma and it is also possible for a mixed tumor to take on malignant characteristics without change of histologic type. The author mentions a tumor of ten to fifteen years' duration which on histologic examination proved to be a typical carcinoma but showed no evidence of underlying mixed tumor.

Treatment by surgery alone has not been very successful, as there has been recurrence in from 20 to 25 per cent of cases. The predominant type of recurrence is local, either encapsulated or infiltrative, but lymphatic metastases rarely occur. Three methods of treatment are described: (1) the tumor may be

left alone to follow its natural course; (2) surgical removal of the tumor and surrounding seedlings; (3) combined surgery and irradiation.

In any mixed parotid tumor it is desirable to avoid active surgical treatment for a time to determine the rapidity of growth. Tumors first appearing late in life may, in the majority of cases, be left alone. Where there is a question of diagnosis, the response to radiotherapy is important as some of the simulating lymphatic conditions are radiosensitive. The only operation which will prevent recurrence is the removal of the tumor with a margin of surrounding salivary tissue by cutting through or outside the gland. This procedure involves, of necessity, the cutting of some or all of the branches of the facial nerve, depending on the amount of gland removed. Other types of operation have been used but all have their disadvantages both from a surgical and pathological standpoint.

Radiotherapy as a primary and sole method of treatment has not proved satisfactory. These tumors vary from slightly radiosensitive to radioresistant. There was no appreciable decrease in the size of the tumor in 6 of the author's cases treated by radium or high-voltage x-ray therapy. Occasionally infiltrating mixed tumors are encountered which are extremely radiosensitive. Combined surgery and irradiation is the most hopeful and practical means of overcoming the disadvantages of surgery alone. Preoperative irradiation is valuable since it renders the capsule tougher and less liable to rupture during operation. Enucleation followed by irradiation is on present evidence the best active treatment for mixed parotid tumors.

MAX CLIMAN, M.D

MISCELLANEOUS

Variation with Wavelength of the Biological Effect of Radiation. I. Lasnitzki and D. E. Lea. Brit. J. Radiol. **13:** 149–162, May, 1940.

Studies were made of the inhibition of mitosis in tissue cultures by x-rays of various wavelengths and of gamma rays. The experimental methods are described.

It was found that x-rays of different wave lengths have the same effect, and are about twice as effective as gamma rays. This difference is shown to be a true one, not to be accounted for by the difference between air ionization and tissue ionization, for it is apparent in terms of tissue as well as in terms of air ionization. Nor is it due to a difference in intensity, as these experiments were made in the region of intensities in which the effect varies with intensity only slightly.

The results are in agreement with those of other experimenters. X-rays and neutrons were found to be about equally effective.

SYDNEY J. HAWLEY, M.D.

The Effect of the Visible Light upon the Biological Strength of Follicular Hormone. Keniti Sakanone. Jap. J. Obst. & Gynec. **23:** 42–50, February, 1940.

The author prepared an aqueous solution of crystalline Pelanin, follicular hormone, and irradiated it by means of various kinds of visible light. This produced no change in the biologic strength, but after colors capable of absorbing the irradiating rays had been added a marked decrease in the biologic strength was induced by irradiation. No visible change, however, was recognized.

WILLIS A. WARD, M.D.

Field Emission X-ray Tube. C. M. Slack. Physical Rev. **58:** 206, July 15, 1940.

This is a brief note—an abstract of a paper presented before the American Physical Society—stating that the Westinghouse x-ray tube with which radiography was performed in a millionth of a second got its enormous cathode current, amounting to several thousand amperes, not from a hot filament, but by cold emission from a metal point. (This is the principle of the old Lilienfeld x-ray tube.)

R. R. NEWELL, M.D.

Design and Preliminary Performance Tests of the Westinghouse Electrostatic Generator. W. H. Wells, R. O. Haxby, W. E. Stephens, W. E. Shoupp. Physical Rev. **58:** 162–173, July 15, 1940.

This is a careful description of the huge pressure tank and Van de Graaff belt electrostatic generator in Pittsburgh. With a pressure of air of 75 lb. to the square inch, a voltage of 4 million has been reached, and the tube has been operated steadily for short times at 3.7 million volts. So far the tube has been used only for acceleration of positive ions, not for x-rays.

R. R. NEWELL, M.D.

A New Electron Microscope. L. Marton. Physical Rev. **58:** 57–60, July 1, 1940.

This is a description of the successful electron microscope with which Zworykin's name has been connected. Successful photomicrographs have been made of various bacteria, etc., with electron optical magnifications on the order of 10,000 to 20,000. The author believes that the self-contained unit can be operated by a practical microscopist who does not necessarily have training as a physicist. He thinks a resolving power of about 50 Å. units can readily be obtained.

R. R. NEWELL, M.D.

A Neutron Generator for Biological Research. L. H. Gray, John Read, and J. G. Wyatt. Brit. J. Radiol. **13:** 82–94, March, 1940.

This article gives details of the construction of a neutron generator using a Cockcroft and Walton circuit to generate 400 kv. It was possible to get about 370 kv. with an ion beam of from 500 to 600μ Å. The apparatus cost about $3,000 and maintenance amounts to about $400 per year.

SYDNEY J. HAWLEY, M.D.

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